The American Journal of Surgery

VOLUME 102 NOVEMBER 1961 NUMBER FIVE

EDITORIAL

Relaxation and Alertness

BOTH THE doctor and the patient need to be prepared for surgery. Some aspects of that preparedness are shared; for instance, both need to be relaxed. This state of relaxation is not a state of being half asleep, indolent or sluggish. What is meant here by relaxation is a state of serenity, freedom from inner conflict or the absence of a state in which the person is working against himself. For example, if there is excessive fear in either the patient or the surgeon, the conditions are not auspicious and somebody is not fully prepared for surgery. This is a relative matter. Surgeons do not like to be considered superstitious, but many surgeons will hesitate, delay or perhaps even refuse to operate if the patient is unswervingly convinced he will not survive the operation. On the other hand, surgeons are accustomed to seeing fear and sometimes are extremely skillful in mobilizing it as a powerful ally of the will to live.

This brings us to a second aspect of preparedness. In addition to being relaxed, both surgeon and patient need to be alert. Here again an explanation is needed. Alertness in this instance means motivation to succeed, anxiousness to win the battle or eagerness to gain a victory. Our term, alertness, is not referring to a level of consciousness, but to a quality, attitude or spirit which may well persist (for all we know) even when the patient is unconscious. We do know that the surgeon's attitude continues to influence him while his consciousness is sharply focused on what his hands are doing.

It is not always possible to achieve these aims, but this in no way invalidates them as aims. Ideally, both the patient and the surgeon should be "up" for the operation, that is, anxious to succeed, and both should be relaxed, serene and free from self-imposed interferences.

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Pathologic Study of 217 Cases of Epithelioma of the Tongue

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THIS paper reports an investigation of 217 cases of squamous cell epithelioma of the tongue seen at the Mayo Clinic during the five year period from 1949 to 1953. The diagnosis of each lesion was verified by microscopic examination. Thirteen patients having only *in situ* lesions were excluded from some phases of the study because their problem was different in some respects. Ten cases in which no treatment was given were excluded from certain phases also. After analysis of the cases, the data compiled from them were compared with a review of 10,454 cases of lingual cancer reported in the world's literature to date.

ETIOLOGY

In the literature one finds a striking statistical association between smoking and cancer of the tongue. Among the general male population heavy smokers approximate 17 per cent [*23*]; however, among patients with cancer of the tongue, heavy smokers constitute from 75 [*9*] to 90 per cent [*21*] of the patients.

Of 121 patients in our series from whom smoking data were available, ninety-four (77 per cent) smoked and most were heavy smokers. In keeping with the findings of Wynder, Bross and Feldman [*23*], 33 per cent were cigar and pipe smokers. No definite correlation was found between the location of the carcinoma and the use of tobacco. Interestingly, 41 per cent of the smokers (including two tobacco chewers) survived five years, whereas 67 per cent of the nonsmokers survived five years. At present we have no explanation for the decidedly better survival rate of the nonsmokers.

Oral sepsis and poor dentition have been incriminated repeatedly as possible etiologic factors in cancer of the tongue [*2,4,21,23*]. Poor oral hygiene and other dental conditions that might contribute to carcinoma were recorded in our study. Often the history of dental sepsis antedated the appearance of the carcinoma by many years.

When the possible causes of lingual cancer are being considered, the demon, rum, usually is high on the list. Correlation with considerable intake of alcohol runs from as high as 75.9 per cent [*21*] to as low as 11 per cent [*13*] (which is actually less than the incidence of heavy drinkers in a cancer-free control group) [*23*].

In only seventeen cases of our series was there a definite history of alcoholism (1 pint or more of whiskey per day), although an additional eleven patients were moderately heavy drinkers, making a total of 13 per cent. Comparison with an incidence of 12 per cent reported in a noncancerous group of patients [*23*] minimizes the significance of alcohol as an etiologic factor.

Syphilis has long been identified as precancerous in relation to tongue lesions. Recent studies have reported from 7 to 33 per cent [*4,6,13,16,21*] of patients with lingual cancer as giving serologically positive results for syphilis. In 201 of our patients examined for this condition, thirteen (6.5 per cent) gave positive results in respect to serologic tests or history of syphilis, or both. In evaluating these figures

one must remember that at present the incidence of positive serologic reactions is decreasing because of antibiotic control of this disease. Six of the thirteen designated patients had basilar involvement, which is somewhat at variance with the preponderance of anterior involvement indicated in the literature [4,23]; however, eight lesions were located classically on the dorsum of the tongue. Only one of these thirteen patients survived five years.

Wynder, Bross and Feldman [23], in an exhaustive and carefully controlled study, analyzed the role of various proposed etiologic factors in oral cancer. Their report deserves careful consideration by everyone interested in the subject. In the literature we find repeatedly the statement that the cause of cancer of the tongue is unknown. Although we fully agree that many factors such as the vagaries of purine metabolism and errors in nucleoprotein synthesis associated with abnormal mitotic patterns in neoplasms are problems yet to be explored, even so we feel justified in listing chronic irritations due to dental irregularities, poor oral hygiene and the use of tobacco as contributing elements in causing lingual cancer.

LOCATION

In the literature considerable emphasis is placed upon the location of lingual epitheliomas, perhaps partly because of the conviction of some investigators that the occurrence and behavior of lingual lesions differ markedly with location in the basilar third and anterior two thirds of the tongue [2,4,6,9,13,16,17,19], and that survival in the two circumstances differs markedly [1–3,12,13,18].

In our study, 48 per cent of the lesions were basilar. If *in situ* disease is excluded, exactly 50 per cent were anterior and 50 per cent were basilar. Although the grade of basilar epitheliomas tended to be slightly higher, the difference in survival referred to in the literature is not striking in our series of cases: 45 per cent of the patients with anterior lesions and 35 per cent with basilar involvement survived five years. (Table 1.) We observed more similarities than differences in the behavior, appearance, grade and prognosis of basilar and anterior lesions.

That the lateral surface is involved much more often than the dorsal or ventral surfaces is well established and requires no further discussion.

TABLE 1
FIVE YEAR SURVIVAL RATES BY LOCATION OF LESION

Location	Patients		Lived Five Years or More after Treatment	
	Total	Traced	Number	Per cent*
Anterior	99	97	44	45.4
Base	95	91	32	35.2
Total†	194	188	76	40.4

* Based on traced patients. Inquiry as of January 1, 1959.
† *In situ* and untreated groups excluded.

GRADING

Ever since Broders in the early 1920's outlined his method for grading malignant tumors, the value of grading has been in controversy. It is not unusual in reviewing the literature to see statements belittling the importance of grading. Although a full discussion of the matter is beyond the scope of this paper, we will state that in our experience at the Mayo Clinic grading does offer some useful information regarding proliferation, infiltration, metastasis and prognosis.

Our finding that ninety-nine patients had grade 1 and 2 disease and 105 had grade 3 and 4 lesions indicates that there are approximately as many high grade as low grade epitheliomas of the tongue. In correlating the grade with the age of the patient, it was noted that 55 per cent of the patients less than fifty years old and 51 per cent of those older had high grade disease. Among thirty lesions measuring less than 2 cm. in diameter, only 40 per cent were of high grade, whereas among the 136 tumors larger than 2 cm. 58 per cent were of high grade.

The relation of grading to metastasis and prognosis [12] is evident in Table II. In considering prognosis (*in situ* or untreated disease excluded) only two instances of infiltrating disease could be classed as grade 1; neither patient had cervical involvement and both survived five years. In ninety traced patients the lesion was grade 2; approximately half had positive nodes and 56 per cent survived five years. In eighty traced patients the lesion was grade 3; three quarters had positive nodes and

TABLE II
FIVE YEAR SURVIVAL RATES BY GRADE OF MALIGNANCY

Grade	Patients		Lived Five Years or More after Treatment	
	Total	Traced	Number	Per cent*
1	2	2	2	...
2	93	90	50	55.6
3	82	80	21	26.2
4	17	16	3	18.8
Total†.....	194	188	76	40.4

* Based on traced patients. Inquiry as of January 1, 1959.
† *In situ* and untreated groups excluded.

TABLE III
FIVE YEAR SURVIVAL RATES BY DEGREE OF INFILTRATION

	Patients		Lived Five Years or More after Treatment	
	Total	Traced	Number	Per cent*
Deep.....	157	151	57	37.7
Superficial.....	18	18	15	83.3
Indeterminate..	19	19	4	21.0
Total†.....	194	188	76	40.4

* Based on traced patients. Inquiry as of January 1, 1959.
† *In situ* and untreated groups excluded.

26 per cent survived five years. In sixteen traced patients the growth was grade 4; nearly 80 per cent of these patients had positive cervical involvement and only 19 per cent survived five years.

INFILTRATION

The relation between the degree of infiltration and the prognosis in this disease may be studied likewise. (Table III.) In thirteen cases of *in situ* lesions, ten patients survived five years, two were untraced, and in one instance infiltrating disease ensued and was responsible for the patient's death. In eighteen cases the infiltration was thought to be superficial to the muscle (Table III); fifteen of these patients survived five years. Among 151 traced patients with deeply infiltrating lesions, fifty-seven survived five years. This is in keeping with the general concept of lingual cancer. That three lesions with superficial penetration and one lesion *in situ* when first seen resulted in the patient's death, however, points out again the fallacy of considering so-called minimal involvements with complete optimism.

SIZE

In most studies the size of the lesion is considered prognostically valuable [*9,10*]. Excluding *in situ* lesions, thirty (15 per cent) in our series were less than 2 cm. in diameter, whereas 136 (67 per cent) were 2 cm. or greater. In the remaining cases the size was unspecified. Of the thirty patients with lesions smaller than 2 cm., 57 per cent survived five years, whereas of the 136 with tumors larger than 2 cm., only 29 per cent survived five years. These findings are in agreement with the general belief that small lesions are less dangerous. The fact that they tend to be of lower grade has been discussed already.

MULTICENTRICITY AND ASSOCIATED CARCINOMA

In the present study seven patients (3 per cent) had lingual cancers with two centers of origin. It is noteworthy that five of these lesions were in the anterior two thirds of the tongue and all but one patient survived five years. Apparently multicentricity does not always affect the prognosis adversely in this disease.

In thirty instances (14 per cent) associated carcinomas were found: oral lesions in ten, extraoral in nineteen, and both oral and extraoral in one. Only five of the affected patients died of their tongue lesion. Seven died of the associated disease, and eighteen (60 per cent of the group) survived five years.

METASTATIC INVOLVEMENT

Incidence of Metastasis. In general the node most commonly palpable on admission is in the deep cervical chain just anterior to the internal jugular vein at the level of the carotid bifurcation [*1,4,11*]. However, epitheliomas at the tip of the tongue often metastasize initially to sites lower in the neck than do those in a more posterior position on the tongue. Figures in the literature on the frequency of finding positive cervical nodes on admission vary from

35 per cent to 61 per cent [*1,2,4–6,8,9,12,20,22*] (and in one report [*13*], 80 per cent). The figures for eventual positive nodal findings are quoted in a smaller range, from 60 to 80 per cent [*2,7,8,13,15*].

In this study fifty-one patients (24 per cent) had positive nodes proved on admission, and an additional thirty instances (14 per cent) were strongly suspected on clinical grounds but without biopsy. Subsequently, nodes were proved to have become positive in twenty-three additional patients (11 per cent), and cervical spread was suspected to have occurred in an additional twenty-eight (12 per cent).

Contralateral Nodal Involvement. Many studies have indicated that contralateral metastasis is common in this disease [*1,13,18,19*]. Perzik and associates [*19*] noted that no patient with bilateral metastasis survived five years.

There were in the present study twelve instances of proved contralateral spread and ten additional instances in which such metastasis was strongly suspected clinically although not proved microscopically. Among these twenty-two patients (10 per cent of our entire series), the primary lesion involved the anterior part of the tongue in fifteen and the basilar region in the remaining seven. Three of the anterior lesions involved only the tip of the tongue. In only ten of the twenty-two cases had the primary lesion itself either crossed or touched the midline. The disease was found on the contralateral side on admission in thirteen cases, spreading to the opposite side subsequently in the remaining nine. In seven cases the primary lesion was grade 2; in five, grade 4; and in the remaining ten, grade 3. Four of the patients (three with metastasis proved microscopically) survived five years.

From these data it is evident that clinically apparent confinement of the primary lesion to one side of the tongue is not an absolute indication that nodal spread has not occurred contralaterally; however, the phenomenon is fortunately uncommon.

To analyze from the opposite base, of twenty-nine patients in whom the primary growth definitely had crossed the midline of the tongue, only seven had bilateral metastatic lesions; of thirteen patients in whom the lesion had reached but not crossed the midline, three had bilateral metastatic involvement. Thus it appears that, once the primary lesion has reached the midline, the chance that contralateral nodes are involved is approximately one in four.

Distant Metastasis. Only ten patients (4.6 per cent of the whole series) had metastasis to sites more distant than the cervical nodes: one to bone (the tenth thoracic vertebra), one to the abdomen, and eight to the lungs. Three of the primary lesions were low grade and four were located in the anterior part of the tongue. Although distant metastasis is relatively uncommon, it occurs with sufficient frequency to warrant taking thoracic roentgenograms in the initial evaluation of lingual epithelioma.

Rate of Spread. How fast a given lesion will metastasize is highly important. In our series the initial examination disclosed cervical metastasis from 28 per cent of the lesions graded 2, 67 per cent of those graded 3, and 84 per cent of those graded 4. Of the grade 2 lesions that subsequently metastasized 25 per cent did so after three and a half years, whereas of the grade 3 lesions that subsequently metastasized 91 per cent did so in less than one year. There was no instance of a grade 4 lesion which metastasized after the initial diagnosis. Thus there should perhaps be more optimism if a patient with a high grade lesion has survived one year after treatment without recurrence.

Survival with Positive Nodes. Over-all five year survival figures in patients with positive nodes are, of course, notoriously poor, varying from 3.6 to 17.8 per cent [*12,14,19,22*].

In our series fifty-one patients on admission had nodes proved positive by microscopy, and metastasis occurred subsequently and was proved microscopically in an additional twenty-three. Of these seventy-four patients, twenty-two (30 per cent) survived five years. Among the thirty patients in whom cervical involvement was found clinically (but not microscopically) on admission and the twenty-eight in whom subsequent development of involvement was suspected clinically, sixteen (28 per cent) survived five years. Thus the over-all survival figure for patients with cervical spread was 28.8 per cent.

LEUKOPLAKIA

Many lesions have been reported as premalignant in relation to lingual epithelioma [*2*]. Although from twenty-four patients of our series no epithelium was available for review, 96 per cent of the remaining 180 had associated leukoplakia. The coexistence of two lesions

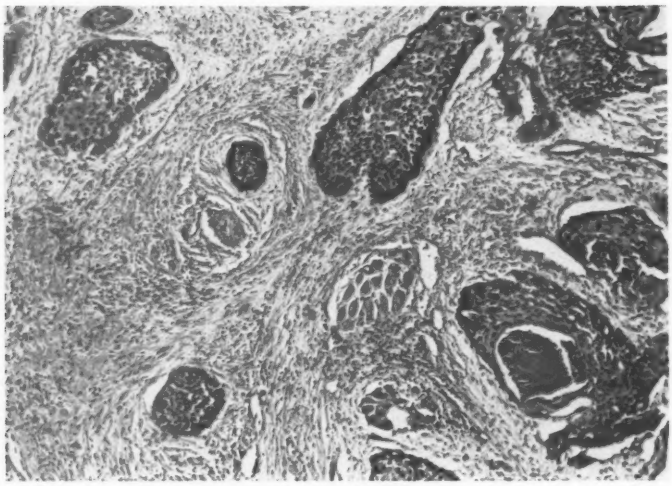

FIG. 1. This grade 3 squamous cell epithelioma shows marked desmoplasia (hematoxylin and eosin stain; magnification × 70).

does not, of course, prove a cause-and-effect relationship; however, the frequent history of prolonged difficulty with leukoplakia before cancer occurred leads us to believe that leukoplakia is indeed an important precancerous lesion.

KERATOGENESIS

The meaning of keratogenesis in a lesion is relatively clear. Since the production of keratin is a function of mature squamous cells, one would expect to find it more prevalent in lower grade lesions; it is obvious from the data that such is the case. Of the ninety-nine infiltrating lesions graded 1 or 2, ninety (91 per cent) showed keratin production. In sixty-five (76 per cent) of the eighty-six grade 3 lesions, keratin was found. In only one grade 4 lesion was there any evidence of keratin production. The difference in survival, however, is less marked than one would expect: of the 156 patients with infiltrating keratin-producing lesions, sixty (38 per cent) survived five years; whereas of the forty-eight patients with infiltrating nonkeratin-producing growths, sixteen (33 per cent) survived five years. Eight of the thirteen *in situ* lesions did not produce keratin.

DESMOPLASTIC REACTION

Study of the desmoplastic reaction (Fig. 1) noted in thirty-one (16 per cent) traced patients with infiltrating lesions was rewarding from the standpoint of positive findings. In scirrhous disease of other parts of the body, notably stomach and breast, the finding of marked interstitial reaction indicates a more aggressive course and a worse prognosis. Similarly, it appears reasonable to assume that in lingual cancer a desmoplastic microscopic picture might be an indication of a more vicious involvement, and such is the case. It is helpful to note that these epitheliomas are more predominantly of high grade, that in the anterior tongue their management seems especially difficult, and that the over-all picture is less favorable, only six patients (19 per cent) of this category in our series surviving five years. Hence we believe that the pathologic report of this finding offers an additional bit of help to the clinician evaluating this disease.

SUMMARY AND CONCLUSIONS

This study reports the pathologic features of 217 cases of squamous cell carcinoma of the tongue seen at the Mayo Clinic in the five year period from 1949 through 1953. Thirteen *in situ* cases and ten untreated cases were excluded from various phases of study.

No correlation was found between the location of the carcinoma and the use of tobacco; however, the percentage of nonsmokers surviving five years is approximately one and a half times that of the smokers.

Poor oral hygiene and chronic irritation due to tobacco seem to be etiologic factors in this disease, but the significance of alcohol as a causative factor is not striking.

We do not believe epitheliomas of the anterior and basilar parts of the tongue should be considered two separate entities.

Low grade and high grade lesions are approximately equal in occurrence. Grading correlates well with the size of the lesion, presence of metastatic involvement and prognosis; we think it valuable in planning the management of the individual case.

The degree of infiltration of the primary lesion correlates well with prognosis; however, so-called minimal involvement cannot be viewed with complete optimism.

Fifty-seven per cent of the patients with lesions smaller than 2 cm. survived five years, whereas only 29 per cent of the patients with lesions 2 cm. or larger survived five years.

Multicentricity apparently does not adversely affect the prognosis in this disease.

Positive nodes were found on admission in 38 per cent of the cases, and cervical spread developed subsequently in an additional 25 per cent.

Involvement of contralateral cervical nodes is relatively uncommon, but twenty-two such instances are reported. Four of these patients survived five years. In only ten of the twenty-nine patients in whom the primary lesion had reached across the midline was contralateral cervical spread recorded.

Metastasis beyond the cervical nodes, although uncommon (4.6 per cent), was mostly to the lungs; therefore thoracic roentgenography is indicated in the initial evaluation of lingual epithelioma.

One quarter of the grade 2 lesions that metastasize subsequent to diagnosis do so after three and a half years, whereas nearly all of the high grade lesions that metastasize do so within one year.

With metastasis, survival is cut approximately in half, but even in the face of metastasis there can be an appreciable salvage. Thirty per cent of the patients with proved metastasis and 27 per cent of those with metastasis strongly suspected clinically but not proved microscopically survived five years, for an over-all salvage of 28.8 per cent in cases with positive nodes.

Leukoplakia is the most frequently associated pathologic finding, coexisting and often pre-existing in 180 patients.

Keratogenesis was of little prognostic significance.

The finding of a desmoplastic reaction in an epithelioma indicates a more aggressive course and a worse prognosis.

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Shoulder and Elbow Lesions of Baseball Players

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STATISTICAL studies by Moseley [1] reveal that 13 per cent [2] of injuries occurring in competitive sports involve the shoulder girdle. Thorndike [3] has reported a total of 7,394 injuries occurring in organized athletics covering a twenty-two year period (1932 to 1954) at Harvard. Eight per cent of these injuries involved the elbow; a total of 20 per cent, which indicates a good number of lesions, were seen in the shoulder and elbow in all sports.

In baseball, in which pitching and throwing constitute a major effort, injuries of the arms are more frequent than those of the legs, as is the case in football. In the legs of course the knee and ankle are much more commonly involved.

The most frequent problems encountered in baseball are those relating to the shoulder. The symptoms usually are pain and often disability of some degree. In examining the shoulder it is necessary to attempt to move the joint through its normal functional range. Limitation of motion is noted as is any muscle weakness, deformity, swelling, crepitus or tenderness. An effort should be made to localize accurately the areas of maximal tenderness. Following physiotherapy, conservative or operative treatment, maximal recovery and complete rehabilitation are determined by observing the player in action during a practice session. Pitchers are particularly observed in relation to their speed of throwing and control. A natural, well coordinated effort observed by a seasoned coach or manager is evidence that competitive pitching may be attempted.

During the spring training period, we ask all players, especially pitchers, to report to the trainer any unusual discomfort, weakness or pain in the arm. There is normally a soreness, discomfort or aching of varying degree in the shoulder and elbow after pitching, certainly before the arm is fully conditioned. Once spring exhibition games have begun, a pitcher is permitted to perform for three innings and to increase his pitching each turn by one inning. At the completion of the training program, it is hoped that he is able to pitch nine innings effectively. The number of pitches during a nine inning stretch of course is variable, but the average is somewhere between 100 to 140 pitches depending upon the variable factor of being able to get the ball over the plate. It has been found that a three, four or five day recovery period is necessary between the starts of pitchers. This of course, again, is relative and depends upon the strength and recovery of each person. During the rest period those small muscle tears which occur in a pitching arm are permitted to heal and the edema to subside. If rest is insufficient during this period, early fatigue and loss of control result. Usually no pitching, such as batting practice throwing, is recommended during this rest period; however, some of the men prefer to throw the ball a bit after two or three days rest, on the sidelines, to "loosen up." This is an individual matter and has to be resolved by the coordinated effort of pitcher, pitching coach and trainer.

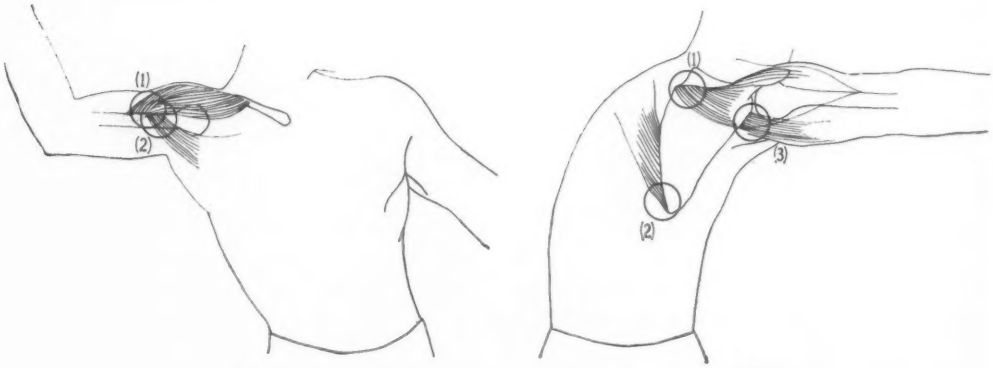
Bennett [4–6], a pioneer, first described elbow and shoulder lesions of baseball players nineteen years ago. Many of the observations he made at that time and subsequently have been recognized as fact. We have found his advice and counsel through the years invaluable.

One might be asked to designate the type of lesion that is particularly disabling to the professional baseball player. Bearing in mind that the player is subject to the same difficulties of the shoulder and elbows as the nonathlete,

FIG. 1. Well circumscribed calcium deposit the size of a coffee bean (arrow) at the lower margin of the glenoid fossa of the scapula. The arm is markedly abducted and externally rotated.

the following lesions are commonly seen: subacromial and subdeltoid bursitis, irritation of the suprapinatus, inflammation of the biceps tendon, and traumatic synovitis involving the shoulder and elbow joints. Obviously due to the excessive and abnormal use of the shoulder and elbow, involvement occurs more frequently in baseball players. It is true that professional athletes are unusually fine physical specimens; still, general health often plays a part in the disability and should always be borne in mind.

The most common injury of the shoulder occurring in professional pitchers is a calcium deposit which develops on the posteroinferior rim of the glenoid fossa and is strikingly similar to the osteoarthritic deposit observed in elderly people. (Fig. 1.) This is due to the excessive use of the arm and the tremendous pull and traction on the posterior capsule of the shoulder joint and the triceps origin. Slocum [7] has illustrated the common areas of periosteal, tendinous and muscular tears (Figs. 2A and 2B) about the shoulder. This is true in his so-called "preparatory phase of pitching" and in the follow-through. The most serious and disabling lesions are the calcifications which are the result of the whip-like action of the arm at the completion of the delivery. The location of this deposit produces an irritation of the joint and the synovial membrane is often attended with pain. In addition, this calcification produces an irritation of the circumflex nerve which passes in immediate contact with it and often results in referred pain anteriorly in the deltoid region. Many patients have extreme tenderness in the posterior axillary fold but complain of pain anteriorly in the deltoid; this of course is a result of referred or radiating pain. The symptoms are local discomfort exaggerated on pitching and sensitivity to palpation. The player, usually a pitcher, has attempted to throw hard and after a couple of innings suffers so much pain and discomfort, posteriorly in the shoulder, that he is unable to continue. He loses his fast ball and often his control because coordination is lost as a result



2A 2B

FIG. 2. A, the preparatory phase of pitching, representing tension and traction arcs. The deltoid at its anterior insertion (1). The pectoralis major insertion (2). Periosteal tears here often respond promptly to trigger point injection. B, the follow-through phase of throwing results in stretching and tearing if the pitcher is not "warmed up" and often attempts to throw with abnormal effort. The posterior deltoid origin (1). The rhomboid major insertion (2). The long head of the triceps at its origin from the infraglenoid tuberosity (3).

of pain. He is either removed from the ball game or is "knocked out."

The length of the warm-up in connection with pitchers is variable. Some men require just a few pitches, other men from eight to ten minutes of throwing. Each man knows pretty well when he is ready, by the speed of the ball and his control. If he is unable to do this, usually a pitching coach or an experienced catcher can tell when a man is ready to enter the game. To quote Bennett, "actually what a pitcher is doing when he is warming up is throwing the ball easily and gradually increasing its speed. He himself can notice that as he begins to stretch, the arm feels loose and therefore he is much more effective because his arm must feel lax at the finish of his delivery. When the arm is tight, the muscles are spastic and effectiveness is lost. One does not have to draw on the imagination to appreciate the tremendous pull on the posterior and anterior shoulder as the weight of the arm is switched forward in a flail-like motion." Occasionally this tightness occurs early in a pitcher's career but more often is evident after many years of pitching, with pain developing which gradually worsens. The pitcher loses his speed, and roentgenograms frequently demonstrate the calcium deposit described.

The treatment of this deposit of calcium is difficult, and of course, is distinctive to the ballplayer. It has been my experience and that of others that operative treatment is not indicated or satisfactory, and therefore is not advised. Treatment primarily consists of intensive physiotherapy with emphasis on the use of the ultrasound which Bauman, our trainer, [8], has described in his paper. We have found that we can expedite recovery with the disappearance of pain and disability by a trigger point injection of Novocain® and one of the steroids. We usually employ 2 or 3 cc. of 1 per cent Novocain or xylocaine solution, depending upon the size of the patient and the muscular development of the athlete. A 22 gauge needle is used to make an intradermal wheal just over the maximal point of tenderness and also to render the procedure painless. A 2, 3 or 4 inch 20 gauge needle is inserted through the wheal and the Novocain injected as the needle is inserted deep to the sensitive area. The Novocain is injected into the trigger point and also fanned out peripherally in the immediate vicinity. This is followed with the introduction of 4 to 8 mg. (1 or 2 cc.) of dexamethasone 21-phosphate or 25 to 50 mg. (1 or 2 cc.) of prednisolone tertiary-butylacetate in the same area. It is usual to follow this injection, as soon as is practical, with ultrasonic therapy. The pitcher continues to perform and may do so within six or eight hours. Usually there is an increase in the discomfort for twenty-four hours and then ordinarily, pain is alleviated. It is often necessary for a man who has this lesion to change his style of pitching because of recurrent persistent pain and failure to respond to the treatment outlined. A young ballplayer, who was recently referred with this lesion, will be unable to continue as an overhand fast ball pitcher, as he has lost his effectiveness. We have suggested to management and the pitching coach that he be converted into a three-quarter or side-arm pitcher. I think this change-over may occasionally salvage a pitcher.

There is another type of injury which is not seen often but which deserves comment. The supraspinatus tendon is subject to great strain, and this has often been referred to as a snubbing of the tendon near the head of the humerus. This results in fraying of the tendon because of its proximity to the head of the humerus and the tuberosity. Here the pain and tenderness are localized to the anterior region of the shoulder. An actual avulsion of the tendon is rare. The fraying, often called a rotater cuff tear, is not amenable to surgical therapy unless it is complete. The treatment is rest, physiotherapy and general supportive measures. An actual complete tear should be surgically repaired because the player is unable to abduct the arm fully. The biceps tendon may also be frayed and occasionally dislocated. The long head follows along in the intertuberculous sulcus. Dislocation of the biceps tendon is uncommon but fraying occurs frequently. DePalma [9] has described a simple operative procedure called stapling for fixation of the tendon in the sulcus. Calcific tendonitis of the long head of the biceps is frequently encountered as are, occasionally, calcifications in the subacromial or subdeltoid bursa. (Fig. 3.) We have advised trigger point injections of Novocain and cortisone in conjunction with ultrasound and have rarely found it necessary to subject these patients to surgery. I believe the results are more gratifying than those obtained from exposure to x-ray therapy which we have discontinued except in the rare

FIG. 3. Very extensive, fairly well circumscribed calcium deposit in the rotater cuff insertion in the region of the greater tuberosity of the humerus (arrow). Some of the calcium may be in the subacromial bursa.

patient who does not respond to the treatment outlined.

The suprascapular nerve supplies the supraspinatus, the infraspinatus muscles and the posterior capsule of the shoulder girdle. Resta [*10*] believes that this nerve is probably irritated as it passes beneath the base of the acromion where it joins the spine of the scapula. We have once again found the use of trigger point Novocain-cortisone injections of the nerve posteriorly most effective in this condition.

In the elbow, the most common condition we have observed has been an epicondylitis involving the medial, more commonly than the lateral, epicondyle. This is due to the pull of the pronator or supinator muscles at their origins. Here again, local injection therapy combined with ultrasound has been most effective. It is frequently necessary to repeat this therapy at four to six week intervals, especially when the player is participating competitively. In intractable cases of epicondylitis, it is occasionally necessary to resort to surgical treatment. Porretta and James [*11*] have advised one or two types of procedures: (1) stripping of the origins of the forearm muscles from the tender area of the epicondyle and (2) transverse sectioning of the overlying fascia and muscle to the bone, about 0.5 cm. distal to the muscle origin on the painful epicondyle.

We have seen an occasional pitcher, usually one who throws a curve or screw ball, who after pitching notes a distinct fullness over the pronator radii teres muscle beneath which are the brachialis and flexors of the forearm just along the medial aspect of the forearm. This area often swells after pitching and is very tender. These muscles are covered by a strong fascial band and often the pitcher will pitch several innings before the swelling becomes so great and painful that he must be removed from the game. This condition apparently is due to hypertrophy of the muscle which occurs when excessive "breaking stuff" is thrown. Occasionally a simple linear or transverse division of the fascia has been helpful in relieving this tension. The swelling usually recedes after rest and physiotherapy. If it comes up each time a man pitches, it is normal for him and becomes a matter of expectation. He will receive some therapy, the swelling will recede after three or four days rest and again he will be ready to pitch in turn.

Loose bodies are rare in the shoulder joint but not too uncommon in the elbow (Figs. 4A and 4B), and are usually the result of traumatic arthritis. When locking of the elbow results, removal of a detached ossicle is justified, although the degree of arthritis and limitation of extension often make the prognosis indeterminate. I have observed a forty-two year old veteran relief pitcher who could throw extremely hard for an inning or two. His only difficulty was that his elbow would occasionally lock while throwing. He would simply shake the arm loose or the trainer would manipulate the elbow, and he would resume effective pitching. This patient had a marked degree of traumatic arthritis. Another most effective pitcher was unable to extend his forearm completely at the elbow because of extensive arthritic change. This made his curve-ball much more effective because in his delivery he was able to make a wide arc with the ball. He required intra-articular steroid therapy at regular intervals to relieve his pain.

Two conditions recently have been called to my attention. They have been called "little leaguer's shoulder" and "little leaguer's elbow" and have been described by Dotter [*12*] and Brogdon [*13*]. Dotter [*12*] has described a "little leaguer's shoulder" as a fracture of the proximal epiphyseal cartilage of the humerus. Brogdon [*13*], who has reported three cases of "little leaguer's elbow," has found that in

4A 4B

FIG. 4. A, multiple detached ossicles of varying size distal to the medial epicondyle of the humerus (arrow). There is roughening of the parent bone in this vicinity. B, an oval partially detached ossicle is seen in the region of the most superior portion of the olecranon process of the ulna (arrow). Traumatic arthritis is evident by the marginal lipping and peaking of the coronoid process of the ulna.

roentgenographic studies of the elbow, separation and fragmentation of the epiphysis and right medial epicondyle and loss of the fascial markings about the elbow are present. I have seen such cases occasionally, occurring in both the shoulder and the elbow, and I believe that we will see these lesions with increasing frequency as our own Khoury Leagues and little league playing continue to increase as they have in recent years. The treatment consists of rest. In most instances, excellent results with full recovery have been obtained in four to six weeks. Occasionally Dotter [*12*] and Brogdon [*13*] have found it necessary to recommend operative treatment with fixation of the epiphysis with a pin.

Recently I have observed a most interesting and unusual case in which a right-handed pitcher complained of pain just below the angle of the scapula in the posterior region of the chest wall on the right side. He had had recurrent pain and discomfort in this area for fifteen months particularly when he attempted to throw his fast ball overhand. He became ineffective and was finally sent to a lower classification in an attempt to rehabilitate him. This patient was intensively treated by Bauman who at times noted a recurrent swelling posteriorly, particularly prominent when the throwing arm was abducted and thrown across the chest at the end of the delivery. Repeated roentgenograms of his shoulder and chest wall were negative for abnormalities. The patient was injected at several trigger point areas from time to time which was temporarily helpful. Finally, in a special view, a calcification was noted on the eighth rib. (Fig. 5.) We were then able to demonstrate clinically that the angle of the scapula glided over this area on the windup and also in the follow-through, and caused much discomfort by a rubbing of the scapula over the bursa and the calcific deposit on the rib beneath the bursa. Crepitation could be elicited. The area was very tender to deep pressure. We assumed that probably this patient had originally had a tear of the lowest digitation of the serratus anterior muscle which is the portion of the muscle under the greatest

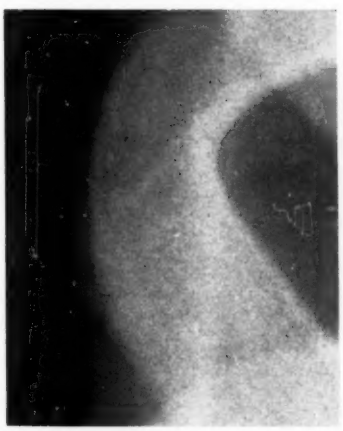


FIG. 5. Localized ossifying periostitis of the convex portion of the right eighth rib in the posterior axillary line. The arm is in the position of abduction and is extended across the anterior chest, throwing the scapula forward.

tension and traction in the follow-through motion of pitching. These muscle fibers originate from the eighth rib. The function of the serratus is to throw the scapula forward and around the anterior chest. We postulated that the calcification resulted from a periosteal tear and the swelling noted was the result of an overlying inflammatory bursa which had been developing for several months. It is entirely possible that this patient may have been overtreated with resultant calcification. When he was admitted to the hospital there was a persistent swelling the size of a baseball at the site described. Since this pitcher was young and had a sound elbow and shoulder, it was thought that surgery was indicated. We believed that improvement was not likely to occur since there had been no response to long periods of rest and to prolonged and fruitless hours of every conceivable method of local therapy.

Accordingly the patient was explored. A large, inflammatory bursa was excised and the calcification removed from the eighth rib together with a good margin of periosteum. Grossly the bursa contained many calcific deposits in its wall which were not discernible on roentgenograms. The fibers of the serratus muscle originating at this area were also divided. I have been unable to find this condition described in the literature and Dr. Bennett does not recall having observed such a patient. It is our hope that the calcification will not recur and that the effectiveness of this player will be restored eventually.

SUMMARY

Some of the more common lesions of the shoulder and elbow occurring in professional baseball players are described. Careful examination including special roentgenologic studies are necessary to arrive at a definite diagnosis.

The therapy is usually conservative and consists of intensive physiotherapy, augmented occasionally by the use of local and enteral steroids. Surgery becomes necessary on rare occasions.

An unusual case of subscapular bursitis with calcification is described. This patient has responded well to surgical removal of the bursa and division of some of the digitations of the supra spinatus muscle.

Acknowledgments: I am indebted to Dr. H. R. Senturia, Radiologist in Chief of the Jewish Hospital, and his associates, for their valuable help in interpreting many of the roentgenograms used in this study. By Dr. Senturia's special technics, we have been able to demonstrate lesions not always discernible by the routine views.

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Female Urinary Stress Incontinence

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STRESS incontinence is characterized by the leakage of urine during activities such as elevated intra-abdominal pressure. It does not occur at rest in the prone or supine positions and only in the most severe cases is there urinary loss in the quiet, erect position. Abrupt rises in pressure induced by coughing, sneezing or laughing may precipitate incontinence in some women who are perfectly continent while performing less strenuous activities. Some patients are incontinent only in the erect position, but the vast majority who demonstrate stress incontinence while in the supine position will do so when erect. To a large extent, this phenomenon is independent of the volume of urine in the bladder and may be demonstrated with as little as 10 cc. of fluid. Muellner [*27*] claimed that sudden stress in these cases precipitates a reflex contraction of the detrusor so that true micturition follows with complete emptying of the bladder. This has only rarely been observed by us for usually only a small trickle of urine escapes.

Its general frequency was estimated from a study of 1,000 consecutive women in an ambulatory gynecologic clinic. Those who had had previous vaginoplasty were excluded and only 3.8 per cent gave incontinence as a primary complaint. In 33.8 per cent of the entire group a history of stress incontinence could be elicited. This figure was surprisingly high but was verified on testing the patients under strain.

Stress incontinence was reported in 14.9 per cent of 334 nullipara. In this group, age was the most significant factor (Table 1) and there was only one case of stress incontinence dating back to infancy.

Among 666 women who had borne children, stress incontinence was present in 43.2 per cent. In this group, parity was more significant than age. (Table II.) Although the number of deliveries is important, the majority of patients with stress incontinence date its onset to an appreciable interval after the birth of a child. It is of interest that six of fourteen women whose pregnancies had always been terminated by Caesarian section had had subsequent stress incontinence.

There is no anatomic concentration of smooth muscle in the region of the vesical neck which can be construed to operate as an orbital or circular sphincter. As early as 1936 Denny-Brown [*8*] suggested that it was a "tubular muscle which relaxed from above downward by some fixed relationship between it and the detrusor." More recently, from animal and human studies, Lapides [*19–24*] also described the involuntary sphincter in women as a tubular structure, the length of at least the proximal three-quarters of the urethra. Sphincteric action is effected by the tension of an outer layer of circular, spiral or sling-shaped smooth muscle and elastic fibers. There is an inner layer of longitudinal fibers continuous with similarly disposed fibers in the detrusor. Contraction of the detrusor exerts a pull on these longitudinal fibers which open the internal urethral orifice by widening and shortening the region of the vesical neck. This theory obviates the necessity for postulating two separate motor mechanisms

TABLE I
STRESS INCONTINENCE IN NULLIPARA

Age Group	No. of Patients	Percentage with Stress Incontinence
0–19	19	5.2
20–29	78	6.4
30–39	81	14.3
40–49	81	20.9
50–59	49	16.3
60–69	23	26.1
70–79	3	33.3

TABLE II
STRESS INCONTINENCE IN PAROUS WOMEN

Age Group	Para I		Para II		Para III or More		Totals	
	No.	Percentage with Incontinence	No.	Percentage with Incontinence	No.	Percentage with Incontinence	No.	Percentage with Incontinence
0–19	1	100.0	1	0.0	...	...	2	100.0
20–29	27	44.4	22	40.9	9	44.4	58	43.1
30–39	48	37.5	48	37.5	41	41.4	138	38.4
40–49	67	28.3	79	43.0	74	55.4	220	42.7
50–59	47	34.0	54	62.9	38	60.5	139	52.5
60–69	21	23.8	31	51.6	35	34.3	87	37.9
70–79	4	25.0	6	50.0	10	30.0	20	35.0
80 or older	1	100.0	...	...	1	100.0	2	100.0
	217	33.6	241	47.3	208	48.5		

in emptying of the bladder; detrusor action and a separate muscle opening a tonically contracted sphincter.

There is still a considerable difference of opinion among anatomists as to the structure of the striated external, voluntary sphincter. The varied concepts include: it is an intrinsic urethral muscle cephalad to the triangular ligament [*31*]; it lies within the confines of the triangular ligament [*6,7*]; it arises within the triangular ligament but extends cephalad to it [*17*]. Roberts [*32*] described striated fibers just cephalad to the triangular ligament which embrace the front of the urethra and splay down the lateral walls of the vagina. Higher up, they encircle the urethra as diagonal slings to reach the base of the bladder behind the internal urethral meatus.

There is also no agreement as to the relation between the pubococcygeal portion of the levator ani and the urethra. Current thought includes the theories that: the pubococcygei lie inferiorly and in close proximity to but send no decussating fibers to the urethra [*17*]; fibers from the pubococcygei insert into the posterolateral aspect of the urethra [*6*]; fibers from the pubococcygei supply the urethra and at times surround its entire length [*7,27*]. Roberts [*32*] concluded that although there may be no direct insertion of fibers from the pubococcygei into the urethra, there are always such attachments to the vagina. Pull on the anterolateral wall of the vagina will indirectly elevate the urethra.

Davies [*7*] believed that fibers from the bulbocavernosi and ischiocavernosi exert a distal sphincteric action by drawing the distal part of the urethra posteriorly.

As continence involves the flow of fluids, this subject can best be considered hydraulically. On one side there is a head of pressure represented by the intravesical pressure and the forces affecting it. On the other side is the variable resistance furnished by the urethra acting as a valve. At rest in the supine position, 150 to 200 cc. of fluid in the bladder produces an intravesical pressure of about 17 cm. of water and often evokes a desire to void. We can assume that the erect position elevates this basal pressure to about 25 cm. by the addition of gravitational force. Moderate straining or coughing produces a pressure of 60 to 75 cm. and severe straining or forced coughing may generate intravesical pressures as high as 120 to 140 cm.

There are four agencies that may furnish resistance to these pressures: (1) the involuntary sphincter; (2) the voluntary muscles, including both the external voluntary sphincter and the pubococcygei; (3) the passive resistance supplied by the mucosa, submucosal vascular plexus and elastic fibers in the urethral wall; and (4) a hitherto undescribed closing mechanism in the compression of the urethra by the same rise in intra-abdominal pressure as acts on the bladder.

Attempts have been made to measure these resistive forces and determine which are defec-

tive in patients with stress incontinence. The sequence of events has been well established by cinefluorography and electromyography, but they furnish little quantitative information. Both Ardran et al. [2] and Lund et al. [25] employed high speed cinefluorography to study the urethra and bladder when voluntary efforts are made to stop micturition. The interruption first appears in the mid-urethra or at the junction of the middle and distal two-thirds. Distal to this constricting point, urine is expelled through the meatus whereas proximally it is actually returned to the bladder. This is a graphic demonstration of the action of the external voluntary sphincter. Forced voluntary efforts to "hold" the stream are also accompanied by elevation of the bladder base, vagina and rectum, which is attributed to pubococcygeal action.

Our original electromyographic studies in 1949, using needle coaxial electrodes inserted perineally into the sphincters and muscles of female subjects, have been confirmed by Petersen et al. [30] with a transurethral approach. Both the voluntary urethral sphincter and pubococcygei are totally inactive when the subject is completely at rest in the supine position. Any effort which would suddenly raise intra-abdominal pressure such as coughing, sneezing or even the erect position will reflexly stimulate these muscles. In the physiologic sense, these voluntary muscle fibers have no tonus. Tonus is an attribute of smooth muscle, and a simplified hypothesis would postulate that continence at rest is maintained by the involuntary urethral sphincter while stress demands the stronger, faster-reacting voluntary muscles or some mechanical valvular action.

Studies have been made to determine if stress continence can be maintained with paralysis of the external voluntary sphincter. Bors [5] demonstrated that this muscle springs from an anlage other than that which later develops into the levator ani and has a separate nerve supply. The external voluntary sphincter is innervated by branches of the internal pudendal nerves given off distal to the ischial spine, while the motor nerves to the levators including the pubococcygei arise from the third and fourth sacral nerves through the pudendal plexus above this spine. Stimulation of the pudendal nerves closed the vesical neck or external sphincter, demonstrable by panendoscopy. Lapides [21,22] blocked these nerves in two normal women without evoking incontinence on cough with a full bladder.

The isolated importance of the pubococcygei is hard to measure. As part of radical abdominoperineal resection the posterior segments of these muscles are excised without alteration of urinary control. A low spinal anesthetic will paralyze both the external voluntary sphincter and the levator ani. Stress incontinence was induced by this means in two of four continent women who had poor anterior vaginal supports but in none of four continent nullipara on coughing vigorously in the supine position with a full bladder. A No. 16 open end catheter was introduced 3.5 cm. intraurethrally in ten erect continent women with 250 cc. of saline solution in the bladder. In none of these did forced coughing result in leakage through the catheter. Apparently, in women with normal pelvic architecture, some other mechanism may preserve continence under stress when the voluntary muscles are rendered inactive.

Another approach to this problem has been to measure the resistance of the urethra to the flow of fluid directed from the meatus to the bladder. The urethra does not contain valves, and theoretically the resistance to flow in one direction should be equivalent to that in the reverse. To record this resistance and avoid reflux, Ingelman-Sundberg [12] applied a glass cone to the urethral meatus. The cone was connected by rubber tubing to a funnel filled with saline solution which was slowly elevated until the saline level began to fall, indicating flow into the bladder. Pressure was measured in terms of height of the fluid level in the funnel above the urethral meatus. In our experience, the cone was unreliable for frequently its open end impinged upon the roof of the urethra. Hartl [10] used a catheter with an olive shaped guard which was placed 16 mm. from its open end to make the system air-tight. Air was insufflated with a bulb syringe and pressure was recorded by a mercury manometer. We have used a combined technic. Two catheters of the Hartl type were employed in succession in each case; one guard was placed 15 mm. and the other only 5 mm. from the open end. Saline solution was perfused from a flask with a Murphy drip incorporated in the tubing. The flask was slowly raised and the level of pressure taken at the onset of the drip.

Lapides [19] did not use a guard and the open end catheter was connected to a cystometry

TABLE III
URETHRAL RESISTANCE IN CONTINENT CASES MEASURED IN CENTIMETERS OF SALINE SOLUTION

Author	At Rest	Holding
Bors [5]	27.4–54.8 cm.	
Ingelman-Sundberg [12]	20–50 cm.	30–70 cm.
Hartl [10]	average 81.5 cm.	average 101.1 cm.
Lapides et al. [19]		
Proximal centimeter of urethra	average 28 cm.	
Second centimeter of urethra	average 46 cm.	average 70 cm.
Third centimeter of urethra	average 51 cm.	
Distal centimeter of urethra	average 21 cm.	

reservoir and a water manometer. The catheter was inserted a measured distance into the urethra and a flow of saline solution initiated from the reservoir. When the pressure in the manometer reached a constant plateau, the flow was interrupted and the column of water in the manometer was permitted to fall to a stationery level. The final height of this column reflected the resistance to fluid flow presented by the segment of urethra between the tip of the catheter and the vesical outlet or, in the case of the distal part of the urethra, the urethral meatus. Our figures for onset of flow were higher than his. Our studies were performed with the bladder empty, whereas in his, 250 cc. of saline solution had been previously introduced.

Patients have been tested at rest and again while consciously attempting to "hold" the stream. Reported results in continent women in the lithotomy position are summarized in Table III. Our averaged findings are indicated in Table IV in which we subdivided our continent subjects into two groups: nulliparous and parous women.

In all cases, when either the 5 or 15 mm. catheter was used, the resting urethral resistance exceeded 20 cm. of saline solution; a level high enough to insure continence at rest. There is considerable doubt in our minds as to whether this method of measuring resting resistance records only the resistance of the involuntary smooth sphincter and the nonmuscular components of the urethra. The urethral resistance as measured with the 15 mm. catheter was equal to or exceeded that with the 5 mm. catheter in 79 per cent of the cases, although with the 15 mm. catheter the length of the perfused urethra is shorter. Inhalation anesthesia in only two of five cases decreased the resting urethral resistance, whereas spinal anesthesia, not only diminished the resting resistance by about 10 to 15 cm. but the resistance with the 5 mm. catheter always exceeded that with the 15 mm. catheter. Many years ago, Langworthy et al. [18] demonstrated the effects of afferent stimuli from the urethra itself. Gradual distention as by perfusion with fluid causes reflex relaxation of the perineal, voluntary muscles. Therefore, the figures gained under spinal anesthesia probably best represent the true resistance of the urethra without any increments added by the voluntary musculature.

On "holding," 77 per cent of these continent women displayed a maximal urethral resistance of 75 cm. and only 44 per cent reached 100 cm. of saline solution or higher. None were incontinent on forced straining which generated

TABLE IV
AVERAGE URETHRAL RESISTANCE IN CONTINENT WOMEN MEASURED IN CENTIMETERS OF SALINE SOLUTION

Cases	No.	5 mm. Catheter		15 mm. Catheter		Percentage of Cases in which 15 mm. Figure Equaled or Exceeded that of 5 mm.		Percentage of Cases with Holding Pressure at Least 75 cm. of Saline Solution	
		Rest (cm.)	Hold (cm.)	Rest (cm.)	Hold (cm.)	Rest	Hold	5 mm. Catheter	15 mm. Catheter
Nulliparous	12	75	83	125	123	100	91	42	91
Parous	22	70	75	83	102	68	62	42	62
Total	34	71	77	98	109	79	73	42	77

much higher intra-abdominal pressures as measured by an intrarectal balloon connected to a water manometer. In one case, the maximal "holding" urethral resistance was 65 cm. while the patient was fully continent with an intra-abdominal pressure of 142 cm. of water on straining. In similar studies in our cases with stress incontinence, we found that the intra-abdominal pressure at which incontinence appeared was usually much higher than the "holding" resistance of the urethra. Only two explanations for this difference appear feasible: either the "holding" resistance as measured by water perfusion contains an artifact possibly due to reflex, unconscious submaximal contraction of the voluntary muscles or there is still another mechanism of increasing urethral resistance under strain. We believe both to be true.

The proximal 2 cm. of urethra lie within the pelvis and are exposed to the same extrinsic forces as are exerted on the bladder. This is clinically detectible by palpating the urethra at rest and when the patient strains. It explains the peculiar observation that during micturition, forced abdominal squeezing increases the rate of urinary flow only slightly despite an enormous rise in intravesical pressure. To study this phenomenon a pressure sensitive transducer was made from a segment of copper tubing measuring 6 inches in length, 5 mm. in diameter, sealed at one end and with its other connected to a strain gauge. Just proximal to its tip, two opposing windows were cut. These were 1 cm. long and so wide that only fine bridges of metal remained. The bridges were crimped and the window covered by fine latex tubing affixed to the metal margins with epoxy cement. With the system filled with water, the gauge could register pressure changes on the window as low as 1 mm. of water. In two normal nullipara, attempts at voluntary "holding" were made with the window placed along successive areas of the urethra. Significant pressure rises were detected at each point. They were most marked in the mid-urethra where 70 cm. of saline pressure was recorded, a level similar to that reached on perfusing the urethra while "holding." This is physiologic confirmation of the distribution of the external voluntary sphincter as described by Roberts [32]. On straining or coughing without any attempt to "hold," the gauge recorded rises of pressure along the proximal half of the urethra of the order of 40 to 50 cm. of saline solution. Only recently, Wolf [33] offered the same explanation for the failure of gastric contents to regurgitate up the thoracic esophagus on straining even though the intra-abdominal esophagus, exposed to abdominal pressure, may be only 1 cm. long. We believe that this mechanism also explains the failure to produce incontinence on strain in normal women when a catheter is introduced through a major part of the urethra.

We have studied some of our cases of stress incontinence to define the pathologic anatomy. Does the defect lie in the smooth muscle sphincter, the extrinsic voluntary sphincter, the pubococcygei or the urethra *per se?* Is there a unitarian explanation for all cases?

A careful gynecologic examination was performed on the previously mentioned group of 1,000 women with results tabulated in Table v. Women may be incontinent without a cystocele, or continent with a cystocele, or incontinence may first develop after an apparently successful repair of a cystocele. In our series, only 37 per cent of the incontinent subjects had a cystocele whereas incontinence was present in 59 per cent of those with a cystocele. Prolapse of the uterus was present in only 8 per cent of the cases with incontinence, but incontinence was noted in 36 per cent of those with prolapse. Women with marked prolapses form a special group. They rarely have stress incontinence and usually have difficulty in initiating the urinary stream. Pre-existing stress incontinence may disappear with progression of the prolapse, to recur after an apparently successful repair which was directed only at the procidentia.

On straining, the bladder base and neck moves only slightly downward and backward in the nullipara and as much as 1 cm. in continent parous women. Abnormal descent of the urethra and vesical neck on straining has been frequently noted in stress incontinence. Aldridge [1] claimed "as a rule, the urethra and vesical neck is displaced downward and forward." Muellner [27] believed that in these cases, not only was there greater descent of the vesical neck, but also, in the erect position, it formed the most dependent part of the bladder. In our series, abnormal descent of the urethra and vesical neck was observed in 62 per cent of the cases of stress incontinence, but only 54 per cent of those with abnormal descent were incontinent. Abnormal descent is usually marked in the severe cases of stress incontinence but is

TABLE V

AVERAGE RESISTANCE MEASURED IN CENTIMETERS OF SALINE SOLUTION IN STRESS INCONTINENCE

Cases	No.	5 mm. Catheter		15 mm. Catheter		Percentage with at Least 20 cm. Pressure at Rest		Percentage with at Least 75 cm. Pressure on "Holding"	
		Rest (cm.)	Hold (cm.)	Rest (cm.)	Hold (cm.)	5 mm.	15 mm.	5 mm.	15 mm.
Nulliparous	6	48	58	70	75	100	100	17	17
Parous	16	48	53	64	63	100	94	31	13
Parous; incontinence main complaint	8	45	50	60	68	85	100	13	13
Total	30	47	57	64	67	97	97	27	17

rarely noted in the postoperative failure. We must emphasize that slight but clinically significant descent of the urethra may not be noted on ordinary vaginal examination.

We have measured urethral resistance to perfusion with saline solution in thirty consecutive cases of stress incontinence. (Table VI.) Two patients had resting resistances slightly below 20 cm.: 17 and 18 cm., respectively; but, the average resistance both at rest and on "holding" was considerably below that of our continent controls. Only 17 per cent could develop a resistance of 75 cm. on "holding." Hartl [*10*] reported that in stress incontinence, the "holding" resistance was often lower than that at rest. This was true in 36.6 per cent of our cases. He explained the paradox as due to scar tissue between the urethra and "damaged" voluntary muscles so that when they contracted in "holding," the involuntary muscle sphincter was actually drawn open rather than reinforced closed. However, we observed this "paradoxical" resistance in 9.9 per cent of our continent controls and, when the 5 mm. catheter was used, in 33.3 per cent of the incontinent cases and 27.2 per cent of the continent controls. Its appearance in normal controls strongly suggests an aberrant reflex response from the urethra and weakens the theory that urethral perfusion gives a direct measure of the force of the voluntary muscles.

Another major closing mechanism in response to strain is also deficient in stress incontinence. For intra-abdominal pressure to exert an effective force directly on the urethra, not only must the anterior wall be free to move, but there must be a strong support for the posterior urethral wall. In virtually all cases of primary stress incontinence, light support of the urethra with two fingers in the vagina, enables the patient to withstand strong coughing without urinary leakage. The same effect is gained by tensing the urethra and anterior vaginal wall with a tenaculum holding the cervix posteriorly. In both instances continence is gained without a change or even an actual reduction in urethral resistance as measured by saline perfusion under anesthesia. It is purely a passive mechanism brought into play by strain.

In stress incontinence the diminution in resistance of the urethra at rest is more noticeable on straining. The proximal half of the urethra is particularly affected as noticed by: cystourethrographic demonstration of funnelling, radiographic-manometric demonstration of easier distensibility of the urethra, and functional decrease in the length of the urethra.

Funnelling is detectable in all cases of stress incontinence when cystograms are taken on straining. It merely implies that the vesical neck is open and so it must be if the patient is to leak urine. In many cases it is even visible at rest, and in others on merely assuming the erect position. Jeffcoate et al. [*14*] popularized the importance of a posterior angle between the urethra and base of the bladder. They claimed that in continent nullipara it was always present, and absent in most cases of stress incontinence. Contrariwise, Ingelman-Sundberg [*13*] and Harper et al. [*9*] found this angle absent in continent women pre- and postoperatively and poor functional results in some

TABLE VI

GYNECOLOGIC FINDINGS IN 1,000 CONSECUTIVE WOMEN

Data	0–19	20–29	30–39	40–49	50–59	60–69	70–79	80 and Older	Total
Nullipara									
Number continent	18	73	69	64	41	17	2	...	284
Number incontinent	1	5	12	17	8	6	1	...	50
Urethral descent									
Incontinent	11%	11%	14%	13%	7%	0	0%	...	11%
Continent	0%	20%	25%	47%	13%	16%	0%	...	28%
Cystocele									
Continent	0%	0%	4%	4%	2%	0%	0%	...	2%
Incontinent	0%	20%	8%	12%	0%	33%	0%	...	12%
Prolapse									
Continent	0%	0%	1%	5%	0%	0%	0%	...	1%
Incontinent	0%	0%	0%	0%	0%	16%	100%	...	4%
Para 1									
Number continent	...	15	31	48	31	16	3	...	144
Number incontinent	1	12	18	19	16	5	1	1	73
Urethral descent									
Continent	...	40%	30%	42%	29%	19%	33%	...	34%
Incontinent	0%	58%	50%	73%	56%	60%	0%	100%	57%
Cystocele									
Continent	...	0%	13%	19%	29%	31%	33%	...	12%
Incontinent	0%	15%	38%	42%	13%	40%	0%	100%	30%
Prolapse									
Continent	...	0%	0%	6%	7%	37%	33%	...	8%
Incontinent	0%	0%	11%	5%	6%	40%	0%	100%	10%
Para II or more									
Number continent	1	18	54	78	35	38	10	...	234
Number incontinent	...	13	35	75	57	28	6	1	215
Urethral descent									
Continent	0%	27%	43%	46%	51%	34%	20%	...	41%
Incontinent	...	54%	71%	80%	70%	64%	50%	0%	71%
Cystocele									
Continent	0%	22%	29%	37%	54%	34%	60%	...	37%
Incontinent	...	31%	49%	57%	42%	25%	16%	0%	45%
Prolapse									
Continent	0%	5%	11%	7%	23%	18%	40%	...	13%
Incontinent	...	0%	9%	9%	9%	11%	0%	0%	4%

cases with good surgical development of this angle. In our estimation, absence of the posterior urethrovesical angle is only an indication of a degree of funnelling.

Funnelling is a radiographic demonstration of the ease with which the bladder neck opens in response to a force directed from above. A method of measuring this was initiated by Kennedy [16] in 1937 and later developed by Barnes [3] and Hartl [10]. Hartl introduced a bag, occupying the urethra protruding slightly into the bladder and connected to a water manometer. The bag was filled with radiopaque medium and radiographs were taken at varied pressures. The normal urethra is only slightly dilated at 50 cm. of water pressure while in stress incontinence dilatation of the proximal half is noticed at levels of 10 to 30 cm. Youssef [34] passed a Miller-Abbott tube through the urethra into the bladder. The balloon was filled with 40 cc. of radiopaque medium while the open end of the catheter was used to register intravesical pressure. On straining, the balloon descended into the urethra only in cases of stress incontinence.

Recently Lapides [19] reported that a characteristic feature of stress incontinence is an abnormal shortening of the urethra in the erect position, when measured with a retention catheter. With relaxation of the vesical neck, in the erect position the bag acts as a wedge and a portion of it descends into the urethra.

Lapides is correct in that the length of the urethra is functionally reduced although anatomically this is doubtful. We have measured its length in the erect position by slowly advancing an open-end calibrated catheter into the bladder which contains only 50 cc. of saline solution. In twenty consecutive cases of moderate stress incontinence, the anatomic length was within 3.8 to 4.6 cm., a normal range. Only very severe cases of incontinence display a reduced length when measured in this manner. The reduced functional length of the urethra also represents easy distensibility of the bladder neck.

It has been assumed that funnelling and this easy dilatation of the vesical neck implied only a weakness of the involuntary sphincter. The older literature suggested a linear spatial relation between the involuntary and voluntary sphincters with the former located at the vesical neck and the latter more distal in the urethra. We believe both muscles extend almost the entire urethral length with one ensheathing the other.

Funnelling and an easily distended vesical neck not only do not designate the anatomic defect but are not even pathognomonic of stress incontinence. Studies by Ardran et al. [2] with high-speed cinefluorography revealed a small beak, measuring 2 to 5 mm. long at rest, which became larger on strain in the majority of women without any urinary disorders. Jeffcoate et al. [14], Youssef [34] and Roberts [32] have also reported funnelling in continent women, some of whom were nulliparous.

Our findings have therapeutic implications. The involuntary sphincter, alone, is not strong enough to withstand stress though it is ideally constructed to maintain continence at rest. This leaves only two possible mechanisms for preserving continence under sharp, large increases in intra-abdominal pressure: the voluntary musculature and direct compression of the urethra by this pressure. Either of these may preserve stress continence but if both mechanisms are wanting, the involuntary sphincter alone cannot withstand strain and dilates readily with urinary leakage.

Multiple operative approaches have been recommended, all of which have been successful in a high percentage of cases and none in all. Some confusion is due to the fact that the abnormal anatomy in most cases of primary stress incontinence usually alters both continence-promoting mechanisms. Loss of support to the posterior wall of the urethra causes a constant stretch of the external voluntary sphincter and if the vesical neck is rotated forwards, there is also a mechanical disadvantage to the obliquely disposed striated muscle fibers. Similarly, the pubococcygeus plays a dual role; its active contraction not only elevates and elongates the urethra to increase its resistance, but its simultaneous contraction with the muscles of the abdominal wall furnishes a counterforce to intra-abdominal pressure.

The recommended therapeutic procedures may be considered from the standpoint of their theoretic objectives.

NONOPERATIVE METHODS

1. Perineal exercises were recommended by Kegel et al. [15] to strengthen the pubococcygei. In our experience this has been of little value although tried for six months in over a hundred cases.

2. A reverse pessary with one edge against the vesical neck and the other in the posterior fornix acts as a counterforce to sharp increases in intra-abdominal pressure. It rarely produces complete continence but is of some palliative value in poor surgical candidates.

3. Estrogens to increase urethral turgor and its passive resistance have been recommended by Lapides [19]. We have had no functional success with them but find them useful in the preoperative preparation of patients with marked vaginal atrophy.

4. Periurethral injection of sclerosing agents or endovesical coagulation of the vesical neck has been used to increase urethral resistance. In several cases so treated by us, obstructive retention was a complication without improvement in the incontinent.

OPERATIVE PROCEDURES

1. Urethroplasty from the vaginal approach has probably reached its most developed form in the Kennedy operation [16]. The urethra is mobilized from meatus to vesical neck and plicated to tighten both involuntary and voluntary sphincters while preserving its full length. Lateral sutures anchor it to the pubococcygei. This operation has had at least a 90 per cent functional cure rate in our experience. We doubt that there are adventitious adhesions fixing the urethra to the pubic bones as described by Kennedy.

2. Advancement of the urethral meatus to a point closer to the clitoris was recommended by Pawlik in 1885 and revived by Berkow [4] in

1941. Lapides has lent experimental support to this operation in that stretching the urethra longitudinally increases its resistance.

3. Retropubic or transvesical narrowing of the vesical neck (Hackenbruch, Smith and Lowsley) was based on the unproved notion that the anatomic defect lay only in that region.

4. Urethrolysis was first suggested by Leander and Ingelman-Sundberg [*12*]. Through a small suprapubic extraperitoneal approach all anterior attachments of the urethra are divided. Mulvaney [*28*], who has recently popularized this operation, believed its efficacy lay in freeing the sphincteric area from adhesions which held it in a stretched and operationally inefficient position. Chalmers and Stabler attributed success to dense readhesions of the urethra to the pubis, but Harper et al. [*9*] found that relief of incontinence occurred before adhesions could form. Lapides [*19*] claimed that the lysis increased the length of the urethra and its resistance. We suggest that division of anterior adhesions permits sudden rises in intra-abdominal pressure to force more easily the anterior urethral wall against the posterior. This demands a good posterior support, and even Mulvaney believed that operation was contraindicated in the presence of an urethrocele.

5. Muscle-tendon transfers were first recommended by Giordano in 1907. Muscles that have been suggested include the gracilis, rectus, pyramidalis, adductor magnus, gluteus-maximus and bulbocavernosus. The theoretic objective was to use a conjoined muscle to reinforce the voluntary sphincter. The thigh muscles do not contract simultaneously with the abdominal muscles and even with the latter, it is virtually impossible to preserve a satisfactory gliding mechanism as secured by orthopedists in the extremities. Ingelman-Sundberg [*12*] had developed a theoretically sound pubococcygeal transfer, by dividing anterior portions of these muscles and suturing them under the urethra and vesical neck.

6. Fascial slings under the vesical neck were recommended by Price (1933) and variations have been added by Aldridge, Studdiford, Millen and Read and Shaw. In all, the sling is a passive supporting structure. Its efficacy lies in supporting the posterior urethral wall and vesical neck during rises in intra-abdominal pressure. Lapides has claimed their use unsound as the increased urethral resistance that they produce cannot be dissipated during micturition.

7. In passive support of the vesical neck, fascial bands between the pubococcygei (Rubin) or vitallium braces (Goldberger and Davids) act in the same manner as fascial slings. They give excellent support but slough of these foreign bodies has been frequent.

8. Urethrovesical suspension was suggested by Furniss (1924) and subsequently developed by Marshall and his colleagues [*26*]. The paraurethral tissues and distal part of the anterior surface of the bladder were sutured to the posterior aspect of the pubis and lower abdominal wall. Their explanation for its modus operandi is vague. Lapides [*19*] sutured the anterior wall of the urethra to the posterior aspect of the pubis to maintain a urethra at least 3 cm. long in the erect position. He has believed that this critical length is necessary to produce sufficient urethral resistance to maintain continence. We have performed the Marshall operation with complete success in fourteen consecutive women who had had failures after previous vaginal procedures. In three of these, postoperative measurements of urethral resistance at rest or "holding" by perfusion of the urethra with saline solution were exactly the same low figures as secured preoperatively. We suspect that its success is due to an artificial, nonphysiologic albeit highly effective closing mechanism on stress, i.e., a valve like angulation of the urethrovesical neck which is fixed to the pubis. Hodgekinson [*11*] had suggested this same phenomenon as one promoting continence in normal women but this is unsupported by cystography. This artificial angulation also explains the continence in total prolapse of the uterus. In one such case we found that the urethral resistance at rest was increased 40 cm. when the uterus was completely prolapsed over that when the uterus was replaced in its normal position.

Most cases of primary stress incontinence are very mild and warrant no specific therapy. Those that do usually have some associated gynecologic disorder in the form of a cystocele, prolapse, rectocele or perineal relaxation that also calls for treatment. In these we believe that a careful vaginal procedure of the type recommended by Kennedy [*16*] will remedy any defects of the anterior vaginal wall and at the same time cure at least 90 per cent of those with stress incontinence. We reserve the urethral suspension for two types: failures after a vaginal operation and those cases of primary stress incontinence without a cystocele or descent of the urethra.

We have measured urethral resistance immediately at the conclusion of vaginal urethroplasties and seek a respectable increase as compared to preoperative measurements. If there is no rise to normal levels, we add additional reefing sutures. An insufficient number have been so tested to qualify its prognostic value at present.

SUMMARY

1. The anatomy and normal closing mechanisms of the bladder are described.

2. The abnormal anatomy and defects of these forces in stress incontinence are described.

3. The rationale of operations designed for its relief are discussed and a choice of procedure recommended.

Acknowledgment: We wish to thank Miss Mary Trausneck and Mr. Sidney Sameth for their kind technical assistance.

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Serum Lactic Dehydrogenase Activity in Acute Abdominal Disease

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AMONG the serum enzymes employed as laboratory aids in making a differential diagnosis, the lactic dehydrogenase (L. D. H.) determination has received considerable attention. Elevations of L. D. H. activity have been recorded for patients with acute myocardial infarction [1], liver and renal disease [2], disseminated cancer [3] and progressive muscular dystrophy [4]. These diverse states probably reflect the occurrence of L. D. H. isoenzymes in widespread tissues. In support of this concept, activities have been established in homogenates of tissue from cardiac and skeletal muscles, the pancreas, spleen, lung and cervix [5] and, under certain conditions, in salivary, biliary, gastric and duodenal secretions [6].

Therefore, it seemed reasonable to us to search for derangements in the serum L. D. H. pattern in a group of patients with acute abdominal disorders characterized by tissue necrosis and/or inflammation. The purpose of this study was threefold: (1) to determine whether or not specific patterns of L. D. H. are associated with specific abdominal disease; (2) to observe the effect of surgical intervention on the subsequent level of the serum value; and (3) to evaluate the clinical usefulness of this test.

PROCEDURE

Serum lactic dehydrogenase activity was measured in 100 hospitalized patients with acute abdominal disease. All patients studied were admitted directly to the Surgical Service or were seen in consultation by that department. Of the total number, fifty-seven patients underwent abdominal surgery which permitted a definitive tissue diagnosis. In the remaining group, the diagnosis was based upon the result of clinical criteria including appropriate laboratory and roentgenologic studies. We excluded from this study patients with acute myocardial infarction, pulmonary embolism, metastatic malignancy and parenchymal disease of the liver revealed by the patient's history and the results of physical examination or tests of hepatic function. The presence of complicating circulatory collapse or renal damage was noted, since these factors may also influence the enzyme value [7,8].

Serum for L. D. H. assay was obtained in almost all instances within sixteen hours prior to operation. Determinations were carried out postoperatively within the first forty-eight hours and in most cases between the fifth and seventh days. Additional observations were undertaken when warranted by the clinical course.

The method employed for the determination of the serum L. D. H. assay has been described previously [1]. In this laboratory, the mean activity and standard deviation in healthy subjects is expressed as 100 ± 20 units at 29°C. Since 140 units represents the peak level attainable within two standard deviations of the mean, this degree of activity is arbitrarily considered to be the upper limit of the normal range. For clarification, L. D. H. values are recorded in terms of four ranges of enzyme activity. (Tables I and II.)

RESULTS

The relationship of serum lactic dehydrogenase activity to diagnostic findings in medically and surgically treated patients is recorded in Tables I and II, respectively. The data for patients in both treatment groups

TABLE I

L. D. H. ACTIVITY IN PATIENTS WITH MEDICALLY TREATED DISORDERS

Clinical State	No. of Patients	No. of Observations of L. D. H. Activity			
		60 to 140 Units	141 to 300 Units	301 to 600 Units	>600 Units
Pelvic inflammatory disease	2	3	...	...	...
Acute gastroenteritis	1	1	...	...	...
Regional ileitis	1	2	1	...	...
Diverticulitis with bleeding	1	4	2	...	...
Large bowel obstruction	4	6	...	...	...
Small bowel obstruction	3	4	...	...	...
Hematemesis (peptic ulcer, gastritis, hiatal hernia*)	16	20	6	...	...
Acute peptic ulcer	5	6	...	...	...
Acute pancreatitis	7	10	11	2	2
Ulcerative colitis	3	4	...	...	...

* This category includes one case of gastric malignancy.

TABLE II

L. D. H. ACTIVITY IN PATIENTS WITH SURGICALLY TREATED DISORDERS

Clinical State	No. of Patients	No. of Observations of L. D. H. Activity							
		60 to 140 Units		141 to 300 Units		301 to 600 Units		>600 Units	
		Pre-operative	Post-operative	Pre-operative	Post-operative	Pre-operative	Post-operative	Pre-operative	Post-operative
Large bowel obstruction	6	3	5	4	8	...	...	...	...
Small bowel obstruction	5	4	6	2	1	...	...	...	...
Small bowel obstruction and gangrene	5	6	4	4	9	...	4	...	1
Superior mesenteric artery occlusion*	1	1	...	...	...	...	...	1	...
Hematemesis	3	3	2	2	5	...	...	...	...
Obstructing duodenal ulcer	3	3	5	1	2	...	...	...	...
Perforated ulcer	1	2	...	1	5	...	...	...	...
Acute pancreatitis	1	...	...	1	1	4	1	...	...
Acute cholecystitis	9	12	8	3	9	1	1	1	...
Acute cholecystitis and choledocholithiasis	2	1	1	1	5	1	...	...	...
Vaginal bleeding	4	2	4	3	2	...	...	...	...
Twisted ovarian cyst	2	2	2	...	...	...	...	...	...
Benign paroxysmal peritonitis	1	1	1	...	...	...	...	...	...
Peritonitis (perforated viscus)	3	6	2	2	10	...	4	...	...
Peritonitis with shock and anuria	4	1	...	...	5	2	5	1	...
Appendicitis	4	3	4	1	3	...	...	...	...
Mesenteric adenitis	2	2	1	...	1	...	...	...	...
Ulcerative colitis†	1	...	...	1	...	...	...	...	...

* Died within six hours postoperatively.
† Died within six hours postoperatively.

TABLE III

ABDOMINAL DISEASES ASSOCIATED WITH DEFINITE L. D. H. ELEVATIONS

Diagnosis	No. of Patients	No. of Observations (preoperative)	Mean Value (preoperative)	Range (preoperative)
Superior mesenteric artery occlusion	1	2	843	94 to 1,592
Peritonitis (with shock and anuria)	4	4	383	100 to 756
Acute cholecystitis and choledocholithiasis	2	3	342	121 to 303
Acute pancreatitis (no operation)	7	25	218	78 to 538
Acute cholecystitis	9	17	191	82 to 910
Large bowel obstruction requiring operation	6	7	163	90 to 252
Small bowel obstruction and gangrene	5	10	144	106 to 502

indicate the serum L. D. H. assay was not elevated in the majority of acute abdominal conditions. With the exception of four cases of subtotal gastric resection, postoperative increases rarely occurred when L. D. H. values were normal prior to laparotomy.

However, the processes of certain diseases do produce a prominent rise in the mean L. D. H. determination. (Table III.) A characteristic feature of these patients was a modest elevation of L. D. H. activity (usually 140 to 300 serum units) in serial studies.

Four of nine patients with acute cholecystitis and five of eight with acute pancreatitis had initial serum L. D. H. levels above 140 units. Of particular interest was the persistent postoperative increase in the level of serum enzyme in five of twelve patients who had had surgery involving the gallbladder, biliary tract or pancreas. Elevated serum L. D. H. activity was also seen preoperatively in two of five cases of obstruction of the small bowel *complicated by gangrene.* In three patients with obstruction of the small bowel who were treated conservatively and in five without visible bowel necrosis at operation, no alteration of the enzyme assay was found. The influence of massive intestinal infarction on the L. D. H. level is emphasized by the serum value of 1,592 units in the patient with occlusion of the superior mesenteric artery.

Obstruction of the large bowel which required surgery produced a rise in the level of enzyme in four of six patients. In three of these four patients, a localized colonic malignancy was responsible for the obstruction.

Although localized peritonitis associated with perforated viscus and benign (nonseptic) paroxysmal peritonitis (Mediterranean fever) did not effect the enzyme level, all four patients with diffuse peritoneal inflammation showed increased serum L. D. H. activity, presumably as a result of accompanying shock and renal failure. (Table III.)

COMMENTS

In reports of previous clinical studies, it has been stated that the serum L. D. H. determination may aid in the diagnosis of intestinal infarction [*9,10*]. The observations presented in this paper suggest that the enzyme level is of limited sensitivity in the evaluation of these patients. The serum L. D. H. assay was normal in all eight patients with small intestinal obstruction without tissue necrosis and in three of five patients with gangrenous bowel. Striking increases, however, may accompany massive intestinal infarction secondary to mesenteric vascular occlusion, as previously reported [*10*]. In this series, the highest L. D. H. value was produced by a thrombosis of the superior mesenteric artery. Even in patients with intestinal infarction where the L. D. H. assay was elevated, other evidence of a necrotizing process existed; i.e., fever, abdominal tenderness or spasm, ileus and leukocytosis. Moreover, our experience indicates that an elevated level of serum L. D. H. was never an isolated finding in *any* of our patients and was not significantly helpful in diagnosis. Earlier reports [*9,10*] did not show that this enzyme test was the sole or most significant index of inflammation or infarction of tissue in patients with acute abdominal disease.

Six of twelve patients with acute inflammatory disease of the gallbladder, biliary tract or pancreas had a preoperative rise in the level of serum L. D. H., and in five it persisted post-

operatively. The explanation may be related to pancreatitis since similarly increased L. D. H. activity (and high serum amylase) was seen in three patients after subtotal gastric resection where operative injury to the pancreas presumably occurred.

It is apparent that the serum L. D. H. assay is unaffected by a wide variety of acute intra-abdominal disorders. Moreover, surgical trauma *per se* cannot be considered a valid cause for postoperative elevations in the levels of serum L. D. H. If increased L. D. H. activity due to biliary tract disease, pancreatitis, intestinal gangrene or hypotension is excluded, only three patients of fifty-seven, who did not have a preoperative elevation in the level of serum L. D. H. had a postoperative rise. In the presence of an abnormally high L. D. H. determination occurring for the first time postoperatively, the clinician should consider cardiac, hepatic or renal damage as causative factors. L. D. H. assays may, therefore, help to diagnose "silent" acute myocardial infarction in the surgical patient [*11,12*].

SUMMARY AND CONCLUSIONS

Serial determinations of serum lactic dehydrogenase activity were performed in 100 patients with acute abdominal disease. Moderate L. D. H. elevations occurred in approximately 50 per cent of the patients with acute cholecystitis, acute pancreatitis or an infarcted small intestine secondary to mechanical obstruction. A patient with massive intestinal infarction due to mesenteric vascular occlusion showed a strikingly high L. D. H. value. Surgical trauma *per se* did not significantly change the serum enzyme level.

An elevated level of serum L. D. H. was never the solitary or most significant index of tissue necrosis; therefore, it is concluded that this test has limited usefulness in making the differential diagnosis of acute abdominal disease.

Acknowledgment: We wish to express our thanks to Dr. Francis D. Moore for his helpful suggestions in reviewing this manuscript.

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Intra-arterial Chemotherapy for Metastatic Cancer to the Brain

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THE intra-arterial infusion of chemotherapeutic agents in the treatment of cancer in various localities has been used for approximately a decade. I was one of the first advocates of this type of therapy and have used it extensively for patients with inoperable cancer [1,2]. The technic consists of placing an indwelling catheter into the artery supplying a regional anatomic site which harbors the cancer. By infusing a chemotherapeutic agent, a larger dose can be concentrated within the cancer. The lesser amount which enters the general circulation results in a lesser degree of hematopoietic depression. This technic has been further refined by the development of the isolation perfusion principle whereby an extremity or an anatomic site is isolated from the rest of the body by ligating its circulation temporarily, so that any material introduced into the isolated anatomic site will theoretically receive all of a given chemotherapeutic agent. By means of an extracorporeal circulation the isolated anatomic region can be the recipient of a perfusate containing a chemotherapeutic agent, and by means of the extracorporeal circulatory apparatus a constant re-infusion of the chemical agent can be maintained for a prolonged period. Oxygenation is usually added to the perfusate to permit proper oxygenation of the isolated extremity as well as for its theoretic benefits in enhancing the effects of the chemotherapeutic agent. This report presents experience in efforts to infuse intraarterially or perfuse by extracorporeal circulatory measures metastatic cancer involving the brain.

MATERIALS AND METHODS

Seven patients with metastatic cancer to the brain have been treated either by intra-arterial infusion of a chemotherapeutic agent or by isolation perfusion of the chemotherapeutic agent. The technic for infusion consisted of exposing the carotid artery and placing a temporary ligature about the external carotid and also the common carotid artery distal to the site of cannulization. The jugular vein on the ipsolateral side is also temporarily ligated. Digital pressure is applied to the contralateral cervical region in an effort to decrease the circulation in the opposite jugular vein. The ligature on the common carotid artery is kept in place for about one minute and the one on the jugular vein for approximately fifteen minutes. Pressure is maintained on the opposite side for approximately twenty minutes.

When perfusion is utilized the common carotid artery is cannulized and the external carotid artery is ligated. The jugular vein is also cannulized and these cannulas are attached to an extracorporeal circulation attached to a pump oxygenator of the disposable type (Abbot) [6]. The pump oxygenator is primed with heparinized blood and the chemotherapeutic agent is added to the blood utilized for priming the pump oxygenator system. After the vessels have been cannulated the jugular vein and common carotid artery distal to the cannulas are temporarily ligated. Digital pressure is made on the contralateral side and the perfusion is continued for a half hour. Subsequent to perfusion the catheter is removed from the common carotid artery and the arterial defect repaired with No. 5–0 atraumatic vascular silk suture. The jugular vein is similarly repaired or ligated permanently.

RESULTS

The data are presented in Table 1. All the patients died. Significantly, each of the patients except one (A. M.) died immediately

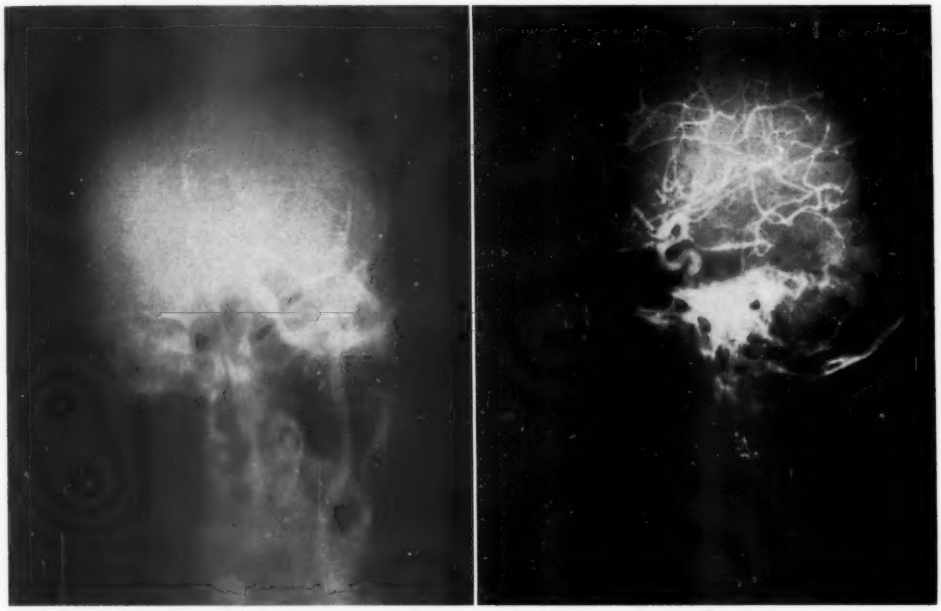
TABLE 1

INTRA-ARTERIAL INFUSION AND PERFUSION-CHEMOTHERAPY FOR METASTATIC CANCER TO THE BRAIN

Patient, Age, (yr.) and Sex	Type and Site of Primary Cancer	Drug and Dose	Type of Administration	Result
I. M., 60, M	Intra-oral squamous carcinoma with extensive cervical metastases	Nitrogen mustard, 30 mg.	Infusion	Jacksonian convulsions; died within 6 hr.
M. P., 55, M	Epidermoid carcinoma of lung	Nitrogen mustard, 25 mg.	Infusion	Postoperative coma; died within 8 hr.
Z. S., 29, F	Melanoma of the right arm	Nitrogen mustard, 20 mg.	Infusion	Jacksonian convulsions; died within 12 hr.
A. M., 30, M	Melanoma of the left leg	Phenylalanine mustard, 50 mg.	Perfusion	Relief of bothersome head pain and somnolence; died 4 mo. later; autopsy revealed metastatic melanoma in the frontal portion of claustrium (8 mm. in diameter), right basal ganglia (1 cm. in diameter) and right occipital lobe (7 by 4 mm. in diameter); hemorrhage into right basal ganglia, right hippocampus and cerebellum
C. B., 34, M	Melanoma of the pharynx, which metastasized to the eye	Phenylalanine mustard, 100 mg.	Perfusion	Contralateral hemiplegia; died within 3 mo.
J. G., 22, M	Melanoma of the left temple	Phenylalanine mustard 100 mg.	Perfusion	Contralateral hemiplegia which improved slightly in 3 wk.; died within 2 mo.
W. M., 46, M	Melanoma of the right wrist	Phenylalanine mustard 100 mg.	Perfusion	Patient comatose before perfusion; moderate transient diminution in degree of coma; died within 7 days

after the administration of the chemotherapeutic agent. Three patients treated by intra-arterial infusion of from 20 to 30 mg. of nitrogen mustard died hours after the administration of the drug. In two of the three patients Jacksonian type of convulsions developed before death and the third lapsed into immediate coma and died twelve hours later. It can accordingly be concluded that the intra-arterial infusion of 20 to 30 mg. of nitrogen mustard into the carotid artery is a most dangerous procedure, being responsible for the death of these three patients. Another patient (J. M.) was in a critical state presenting evidence of far advanced brain damage at the time of infusion; the degree of damage to the brain as a result of the disease could be a contributing factor, with the additional trauma resulting from the chemotherapeutic agents being the necessary additional trauma to be incompatible with life. Two other patients (M. P. and Z. S.) were in relatively good condition with mild to moderate symptoms and signs indicating metastasis to the brain; their death can be attributed directly to the infusion of from 20 to 25 mg. of nitrogen mustard dissolved in 50 cc. of saline solution. The additional four patients, each of whom had metastases of malignant melanoma to the brain, were treated by perfusion of phenylalanine mustard.* Each patient treated by "isolation perfusion" except one (A. M.) died shortly after the perfusion. Each patient except one developed a hemiplegia of the contralateral side following the perfusion, which hemiplegia occurred on the day after the perfusion. This would indicate that the brain damage was not immediate but rather required a time interval to develop as a result of the chemotherapeutic agent. One patient (W. M.)

* Mephalan is manufactured by Burroughs Wellcome and Company, Tuckahoe, New York.



1A 1B

FIG. 1. Anteroposterior (A) and lateral (B) arteriograms of a patient (C. B.), taken after the development of contralateral hemiplegia which occurred twenty-four hours after the perfusion of 100 mg. of phenylalanine mustard into the right internal carotid artery. The circulation is considered to be normal.

was comatose as a result of metastases before the perfusion was started. He experienced a moderate diminution of the degree of coma but never became completely oriented. He then gradually lapsed into a deep coma and died seven days after the isolation perfusion of his brain. The only patient who survived any period was patient A. M. who received 50 mg. of phenylalanine mustard. He enjoyed a relief of bothersome head pain which could not be controlled by any form of medication and also from severe somnolence from which he suffered. He remained well for two months when signs and symptoms of severe brain disturbances developed. A decompressive operative procedure was attempted but the patient died the subsequent day. Autopsy revealed small foci of metastatic melanoma in his brain and hemorrhage in regions of the brain distant from the site of metastatic malignant melanoma.

The data pertaining to the four patients treated with phenylalanine mustard would indicate that 50 mg. might be considered a safe dose (providing the hemorrhage noted two months later at autopsy in patient A. M. was not caused by the chemotherapeutic agent) whereas the higher dose of 75 to 100 mg. caused hemiplegia on the day after perfusion. These observations demonstrate that these doses are too toxic under the conditions of these experiments.

COMMENTS

The brain damage could be caused either by (1) occlusion of the internal carotid artery or one of its branches by thrombus or other reasons, (2) the effect of the drug directly on the brain tissue, or (3) anoxic reaction.

An arteriogram of patient C. B. on the day after perfusion revealed normal vascular structures. (Fig. 1.) Each perfusion was performed under high oxygenation, hence anoxia does not seem to be the cause. It is concluded that the results are directly related to the effects of the chemotherapeutic agents upon the brain tissue.

SUMMARY AND CONCLUSION

The results would suggest very strongly that under the conditions of this experiment the intra-arterial infusion of from 20 to 30 mg. of nitrogen mustard and the isolation perfusion

of from 75 to 100 mg. of phenylalanine mustard are too toxic a regimen for treating patients with metastatic cancer to the brain.

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Bilateral Adrenalectomy for Advanced Breast Cancer

REVIEW OF THE LITERATURE AND ANALYSIS OF TWENTY-FIVE CASES

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BILATERAL adrenalectomy was introduced by Huggins and Bergenstal in 1951 [*19*] for palliation of advanced breast cancer. It was based on inferences implicit from the facts that breast cancer is estrogen sensitive, that it occurs less commonly in adrenalectomized animals and that the adrenal glands are the main extragonadal source of estrogen production [*16,17,23,31*]. The operation was attempted in 1945 [*22*] and in 1947 [*7*], but was not successful because of lack of cortisone. It became practical soon after cortisone became available for clinical use.

Huggins' initial report in 1951 included four patients with breast cancer. Two of these showed marked improvement, one slight improvement and one no improvement following adrenalectomy. As the operation gained wide acceptance, the number of cases steadily increased [*3–5,9,11–15,18,20,25,26,29–32*]; 948 had been reported by June 1960 [*8*]. Excluded are many small series and twenty-five new cases reported recently [*27*]. As a result of these studies, the indications, the possible means of preoperative selection and the special problems of management of the adrenalectomized patient have been outlined and methods of assessment of the results standardized.

Observations based on analysis of large series [*3,8,12,25,31*] indicate that patients with metastases to bones, soft tissues, regional lymph nodes and skin, and those with inflammatory carcinoma tend to respond favorably to adrenalectomy. Patients who have massive liver metastases with ascites and jaundice, infiltration of the pulmonary lymphatics or brain metastases are less likely to respond [*3,8,12,31*]. Theoretically, only 40 to 50 per cent of breast cancers are estrogen sensitive [*16,23,28*]; patients with any of these can be expected to benefit from adrenalectomy. Preoperative selection of patients is based on several clinical and laboratory observations. The characteristics of estrogen sensitive breast cancer are as follows:

A. Clinical
   1. Remission following previous oophorectomy
   2. Clinical improvement following cortisone treatment (150 mg. daily for three days)
   3. Aggravation of symptoms by stilbestrol (15 mg. daily for three days)
   4. Clinical improvement following treatment with androgens (50 mg. daily for five days)
   5. Lactation of healthy breast after luteotrophin stimulation (500 units daily for seven days)

B. Laboratory
   1. High level of estrogenic substances in urine (over 15 units/24 hours)
   2. High urinary 17-ketosteroid level (over 2 mg./24 hours)
   3. High level of estrogens of adrenal origin
   4. Marked estrogen effect on vaginal epithelium
   5. Increase of serum and urinary calcium by stilbestrol stimulation
   6. Decrease of serum and urinary calcium following cortisone treatment

Assessment of the results has been well standardized in recent collective reviews [*8*] or reports of large series [*1,2,12,26,29,31*]. Objective evidence of improvement for at least six

TABLE I
AGE DISTRIBUTION

Age (yr.)	No. of Patients
21 to 30	1
31 to 40	2
41 to 50	8
51 to 60	9
61 to 70	5
Total	25

months is considered a standard base for comparison of the results. It implies clinical or radiologic evidence of arrest or regression of metastases, or laboratory evidence of arrest of disease for that period of time. Subjective improvement usually accompanies objective response and is characterized by ambulation, complete relief of pain, improvement in appetite and a general sense of well-being. Some authors view subjective improvement as evidence of favorable response since there is excellent palliation in spite of absence of objective improvement [*4–6,10*]. Definite prolongation of life accompanies objective response.

Nelson and Dragstedt [*26*] recently reported twenty-four patients followed for three to eight years after adrenalectomy and oophorectomy. Fourteen had objective response and survived an average of forty-four months; five (20 per cent) have remained asymptomatic for an average of sixty months.

Dao [*8*] in 1960, reviewed observations based on 948 reported cases. Over-all mortality was 9 per cent; objective remission rate was 43 per cent for combined oophorectomy and adrenalectomy (882 patients) and 38 per cent for adrenalectomy alone (238 patients).

TABLE III
LOCATION OF METASTASES

Location	No. of Patients
Bone	20
Regional nodes	8
Skin	3
Lungs and pleura	6
Brachial plexus	4
Liver	3

TABLE II
HISTOLOGIC TYPE OF BREAST TUMOR AND AXILLARY METASTASES

Histologic Type	No. of Patients	Axillary Metastases		
		Present	Absent	Unknown
Scirrhous	10	5	2	3
Adenocarcinoma	3	2	1	0
Medullary	3	3	0	0
Mucinous	2	0	2	0
Intraductal	1*	0	1	0
Inflammatory	1	1	0	0
Unknown	6	0	0	6
Total	26	11	6	9

* This patient had scirrhous carcinoma in one breast and an intraductal tumor in the opposite breast.

MATERIAL

Twenty-five patients with advanced carcinoma of the breast were subjected to adrenalectomy between November 1953, and December, 1960. All had severe symptoms due to widespread metastases. Most were confined to bed because of pain, cachexia, bone metastases with pathologic fractures, pleural effusions or other manifestations of advanced disease.

Age at time of adrenalectomy averaged 52.2 years; the youngest patient was twenty-nine years of age and the oldest was seventy years of age. Fourteen patients were in their fifth and sixth decades. (Table I.) Ten were premenopausal and fifteen were postmenopausal or within five years of menopause.

The histologic type of the initial tumor and the status of the axillary lymph nodes at time of mastectomy were known in nineteen patients. Scirrhous carcinoma was the predominating type. (Table II.)

Metastases were manifest within six months of mastectomy in four patients, from six months to one year in five, and from one to two years in eight. They developed from two to six years following radical mastectomy in the remaining eight patients. The most common sites of metastases are given in Table III.

Intractable pain was by far the most common symptom. Its distribution was closely associated with the location of metastases,

especially in bone lesions. Neuritic pain commonly occurred with collapsed vertebrae or with brachial plexus involvement. Cough, dyspnea and pain in the chest were common with metastases to the lungs or pleura. Osteolytic lesions with pathologic fractures, massive enlargement of lymph nodes, multiple skin nodules, edema of the arms and pleural effusions were usual clinical signs of advanced disease. Several patients appeared emaciated and twelve were confined to bed. Narcotics were administered in increasing doses and at short intervals with little benefit.

Most patients had received various types of palliative treatment in a concurrent or sequential form. Radiation therapy was given to twelve patients, androgens to eleven and estrogens and cortisone to four. Six patients had therapeutic oophorectomy. One with visceral metastases received nitrogen mustard following oophorectomy. Four of the oophorectomized patients had a good response. This multiplicity of palliative agents makes evaluation of their individual effect extremely difficult. The process becomes even more complicated when patients who had therapeutic oophorectomy are evaluated. Most were receiving androgens or x-ray therapy or both; any favorable effect may have been due to one or any combination of the agents.

PREOPERATIVE SELECTION AND PREPARATION OF PATIENTS

Selection of patients for adrenalectomy was based on careful clinical evaluation rather than on complicated laboratory determinations. Biochemical studies and vaginal smears to detect the status of estrogenic activity were carried out for only a few patients. Most relapsed after short relief following irradiation, hormonal therapy or oophorectomy. Adrenalectomy was considered the last available measure for palliation in these patients.

Special preparation with cortisone was initiated two days before the operation. The regimen employed for most patients is given in Table IV.

Intravenous administration of hydrocortisone was occasionally used during the operation and for rapid preparation of a few patients starting the morning of operation. A sense of well-being, absence of orthostatic hypotension, tachycardia, weakness or hyperthermia were clinical criteria of adequate cortisone replacement. Changes in dietary salt intake, combined with desoxycorticosterone acetate (DOCA) early in the series and α-fluorohydrocortisone later, were used to maintain blood pressure and prevent loss of sodium or retention of water.

TABLE IV
PREPARATORY AND MAINTENANCE DOSAGES OF CORTISONE ACETATE

Day	Dosage
Before operation	
2	50 mg. intramuscularly every four hours
1	50 mg. intramuscularly every four hours
Day of operation	100 mg. intramuscularly and 100 mg. orally one hour preoperatively
After operation	
1	50 mg. intramuscularly every four hours
2	50 mg. intramuscularly every six hours
3	50 mg. intramuscularly every eight hours
4	50 mg. orally every eight hours
5	50 mg. orally every twelve hours
6	25 mg. orally every twelve hours

OPERATION

Bilateral total adrenalectomy was performed in one session for twenty-four patients. In one patient, excessive hemorrhage and shock forced interruption of the operation after unilateral adrenalectomy. An anterior transabdominal approach was used on nine patients, seven of whom had oophorectomy performed as a combined operation. A posterolateral retroperitoneal approach through the bed of the twelfth rib bilaterally was used on the remaining sixteen patients. Approximately 1,000 cc. of blood was given to each patient during the operation. Careful dissection with liberal use of silver clips for the small vessels and ligation of the larger veins are routine parts of the procedure. Occasionally, the right adrenal is adherent to the inferior vena cava, particularly when it is involved by metastatic disease;* extreme care in dissection is required to avoid vascular injury. Hydrocortisone drip

* Five of our patients (20 per cent) had metastases to the adrenals and three more had an adrenal cortical adenoma.

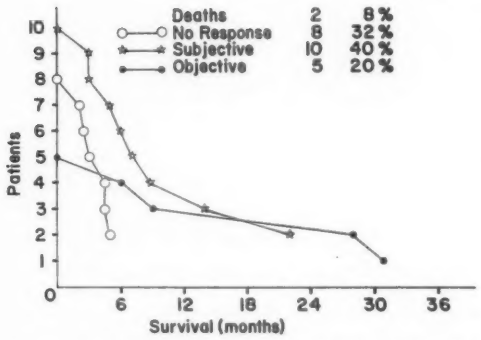

FIG. 1. Depicted above are the results and survival periods for twenty-five patients.

was used only when hypotensive episodes not explained by loss of blood occurred.

COMPLICATIONS

Complications were related either to technical aspects of the procedure or to postoperative management. (Table v.)

The problem of adrenal substitution requires the most careful attention to avoid overdosage or inadequate replacement of cortisone. It was the complicating factor in six instances among our patients. One death on the sixth postoperative day followed severe operative hemorrhage and shock; one on the twenty-seventh day followed two episodes of adrenal failure. These constitute the mortality incidence for the operation (8 per cent).

TABLE V
TECHNICAL AND POSTOPERATIVE COMPLICATIONS

Complication	No. of Patients
Technical	3
Excessive hemorrhage	1
Injury to spleen	1
Injury to vena cava	1
Postoperative	
Immediate	7
Acute adrenal insufficiency	2
Pleural effusion	2
Shock	1
Convulsions	1
Peritonitis	1
Late	2
Adrenal insufficiency	1
Convulsions	1

RESULTS

Of the twenty-five patients, two died within a month of operation. Eight more failed to respond to adrenalectomy; six of these died within an average of three and a half months; two are still alive after two months. (Fig. 1.)

Although subjective response is often disregarded in evaluation of results, we consider it most rewarding to observe the comfort and sense of well-being of patients who, preoperatively, were gravely ill and physically and emotionally withdrawn from active life.

Ten patients showed evidence of subjective response as expressed by ambulation, complete relief of pain, decrease in coughing and dyspnea, improvement of appetite and a sense of well-being. Our observation that patients could completely eliminate or markedly decrease their need for narcotics agrees with that of Katz and Saltzstein [*24*]. The duration of the improvement averaged 6.5 months. Only one patient was free of symptoms twenty-two months after operation. The average survival time for eight patients was 8.5 months. Two are still alive, two and eight months postoperatively.

Five patients had definite evidence of objective response as defined by clinically measurable or radiologically evident improvement of metastatic lesions. (Table VI.)

These patients also had all the characteristics of subjective response. The duration of the response was over six months in all but one patient, the average duration being sixteen months. Four patients died after an average survival of 18.5 months. One patient has been asymptomatic for thirty-two months following adrenalectomy.

TABLE VI
OBJECTIVE RESPONSE IN FIVE PATIENTS

Response	No. of Patients
Bone healing	2
Decrease in size of nodes	2
Decrease in size of skin nodules	2
Decrease in arm lymphedema	2
Decrease of inflammatory carcinoma	1
Absorption of pleural effusion	1

CASE REPORT

The following case report illustrates the change that occasionally follows adrenalectomy:

CASE 1. A sixty-eight year old woman had widespread bone metastases from scirrhous carcinoma of the left breast, collapsed vertebrae, several pathologic fractures of the ribs and a fracture of the neck of the left femur. She had severe pain and tenderness, even to slight touch, with little relief from narcotics; she was confined to bed in a terminal status. Repeated courses of irradiation and administration of androgens, estrogens and cortisone ceased to act after short periods of relief. She had hypertension with cardiac changes, arrhythmia and borderline decompensation. After the aforementioned necessary precautions and preparation, a bilateral adrenalectomy was performed. Within one day the pain disappeared; the patient was ambulatory one week later. She remained free of pain, ambulatory and in remission for twenty-two months. She died suddenly at home after momentary retrosternal pain, cyanosis and cold sweats. The cause of death was probably cardiac.

COMMENTS

The twenty-five cases reported herein represent patients personally followed from the beginning of the disease to its terminal phase or to the patient's death.

Aside from attention to the locations of metastases and the presence of severe uncontrollable symptoms, few means of preoperative selection were used. Detailed biochemical determinations were occasionally employed. In several patients, adrenalectomy was considered the last available means of palliation.

The two deaths and most of the complications occurred early in the series. There were no complications in the sixteen patients who were operated on most recently.

The 20 per cent rate of objective response is lower than that obtained in other series [*2,9,12,18,31*]. The following facts may account in part for this low rate: (1) the operation was employed during the late stages when the bulk of metastatic disease was overwhelming, (2) the selection was not always based on hormonal evaluation of patient and tumor by detailed methods and (3) no postoperative laboratory or radiologic evaluations were carried out routinely.

We consider subjective response worth reporting, since it was associated with dramatic improvement in some of our patients. However, its short duration and the patient's shorter survival period are indicative of the superiority of the objective response as a basis for evaluation of results.

It has been stressed in several reports [*21,26*] that patients with well differentiated tumors and those who develop metastases two or more years after mastectomy respond better to adrenalectomy. In this small series, the histologic type of tumor could not be related to response to the operation. The length of time from mastectomy to the appearance of metastases seemed to correspond inversely; five patients in the failure group had developed metastases two to six years following mastectomy.

Failure of three patients with liver metastases to respond to the operation is in agreement with data from other reports [*8,12,31*].

Of six patients who had had a therapeutic oophorectomy previously, four had good response for twenty-five, fifteen, twenty-four and twelve months, respectively. Two of the four had additional good response from adrenalectomy for seven and eight months. The fifth patient, who had only fair response from oophorectomy, has been in remission for thirty-two months following adrenalectomy. The sixth, who had no relief from oophorectomy, has been free of symptoms for two months following adrenalectomy.

SUMMARY AND CONCLUSIONS

Bilateral adrenalectomy for advanced breast cancer has now been reported for over 1,000 patients. Its mortality and morbidity are acceptable and its effect is beneficial for 40 to 55 per cent of the patients [*8*].

Twenty-five patients were operated on during the seven years of our study. The most consistent criteria were extremely symptomatic uncontrollable metastases. Five patients had definite objective response with marked prolongation of active life, ten had only subjective response for an average of 6.5 months, eight had no response and two died within one month of the operation.

The operation should be considered and applied in the early stages of metastatic disease which cannot be controlled by local operation and irradiation or both, if favorable results are to be obtained [*26*]. Best results have been obtained in patients with evidence of estrogen

sensitive tumors with metastases located in the bones, the regional lymph nodes and/or the skin, or in those patients with inflammatory carcinoma.

With good preparation and management and with familiarity with details of the procedure, excellent palliation may be obtained in patients in whom other less radical methods have failed.

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Observations on Coronary Sinus Flow

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IT WAS the object of this study to investigate the influence of hemorrhagic hypovolemia and of blood transfusions upon coronary sinus flow, as well as the effect of administration of blood, 50 per cent dextrose solution, and physiologic saline solution in the hypovolemic animal.

A direct method which has been previously described was utilized [1]. This involves operative catheterization of the coronary sinus by means of a catheter introduced through the external jugular vein. Spillage about the catheter tip is prevented by placing a ligature snugly around the coronary sinus. The catheter is allowed to drain freely by gravity into a graduated burette from which the blood is returned via a catheter in the femoral vein by means of a sigmamotor pump. Flow can be determined by momentarily stopping the pump and determining the number of seconds necessary for accumulation of a given quantity of blood in the burette. Essentially the same method has also been utilized by Vowles and his associates [2].

EXPERIMENTAL DESIGN

Healthy mongrel dogs were anesthetized by the intravenous administration of sodium thiopental. Tracheal intubation was carried out and respirations were controlled with an intermittent positive pressure machine using 100 per cent oxygen. A thoracotomy incision was made, the proximal portion of the coronary sinus dissected free and a loop of silk placed about it. The catheter was introduced into the coronary sinus via the external jugular vein. Another catheter was introduced into a femoral vein, and a third into a femoral artery and connected with a U tube manometer in order to permit measurements of mean arterial pressure. The coronary sinus catheter was allowed to drain by gravity into a graduated burette following placement of a snug ligature about the coronary sinus and the tip of the catheter. When flow studies were not being determined, the blood draining into the burette was returned via the femoral vein at a rate which maintained a constant level in the burette. The first flow studies were made after the catheters had been in place for five minutes and the animal's condition was stable. In those animals which were to be bled, an additional catheter was placed in the aorta via the other femoral artery.

Twenty-three animals were studied before and after rapid removal of 20 cc. per kilogram of body weight of blood. Following three determinations of coronary sinus flow at five minute intervals, the animals were bled rapidly. After the completion of hemorrhage, coronary sinus flows were measured at five minute intervals during the following twenty minute period. The initial control measurements were averaged. This mean value was considered the control value.

In ten animals following the twenty minute posthemorrhage stabilization period, the blood which had been removed was returned rapidly intravenously by adding it to the burette. In five of the animals the sinus flow and blood pressure were measured one minute later and in all ten such measurements were made at five minute intervals during a twenty minute period.

Eight animals were studied in similar fashion to learn the effect of the rapid administration, via the burette and femoral catheter, of 20 cc. per kilogram of body weight of isotonic saline at the completion of the posthemorrhage period

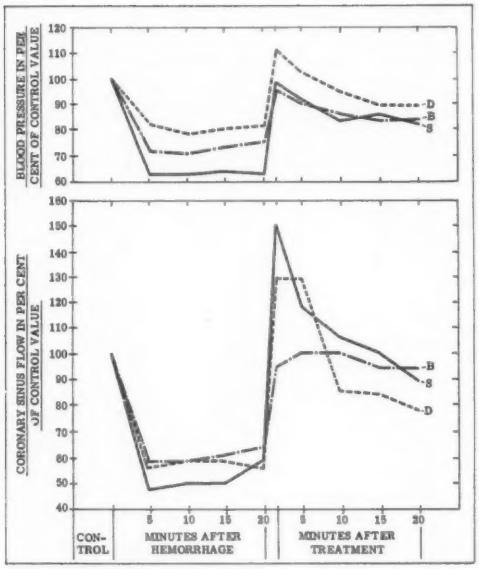

FIG. 1. Chart showing mean changes in per cent of control in the three groups of dogs subjected to hemorrhage, one treated by blood replacement (B), a second by infusion of physiologic saline solution (S) and the third by administration of 50 per cent dextrose solution (D).

of observation. Sinus flows and arterial pressures were measured one, five, ten, fifteen and twenty minutes thereafter.

Twenty minutes following hemorrhage five animals were given 50 per cent dextrose solution via the burette in a dose of 2.1 cc. per kilogram of body weight. Blood pressure and sinus flows were determined one minute later and at five minute intervals during the next twenty minute period.

Following the initial control study period, eight animals were transfused rapidly by means of the measuring burette and the sigmamotor pump. Twenty cubic centimeters per kilogram of body weight were administered in from one to three minutes. Coronary sinus flows and systemic pressure were measured every minute for the first five and every five minutes thereafter during the twenty minute period of observation.

RESULTS AND COMMENTS

Considerable variation was noted in coronary sinus flows as expressed in cubic centimeter per kilogram per minute and also in mean arterial pressure. The trends noted in each group of experiments, however, seemed clear-cut and the mean values in each experiment accurately reflected these trends. The mean control coronary sinus flows in the four groups studied ranged between 3.4 and 4.4 cc. per kilogram per minute, the average mean arterial blood pressure between 117 and 130 mm. Hg.

Effect of Hemorrhage. Rapid withdrawal of 20 cc. per kilogram of body weight of blood brought about a variable drop in systemic arterial pressure in almost all of the twenty-three animals studied. In two, however, the arterial presssure remained the same and in a third there was only a slight depression. In contrast, a rather marked hypotension followed in a few. The average mean arterial pressure fell to a level of approximately 70 per cent of the control value and remained at this level during the twenty minute period following bleeding. All animals, including those in which no hypotension developed, underwent a substantial decrease in coronary sinus flow. The mean value was 51 per cent of the control five minutes after hemorrhage, 54 per cent in ten minutes, 57 per cent in fifteen minutes and 59 per cent twenty minutes after hemorrhage.

Rapid Transfusion. The rapid intravenous infusion of whole blood brought about only a slight and somewhat inconsistent increase in mean arterial pressure. Indeed, in three of the eight animals studied the pressure did not rise. The average values were only 105 per cent of the control one minute after transfusion, 108 per cent, two, three and four minutes later, and 103 or 104 per cent five, ten, fifteen and twenty minutes after transfusion. Each animal, however, exhibited an increased coronary sinus flow following the transfusion. The average coronary sinus flow was 114 per cent of the control one minute after transfusion, 123 per cent five minutes, 125 ten, 120 fifteen and 111 per cent twenty minutes following the transfusion.

Hemorrhage and Whole Blood Replacement. Each of the ten hypovolemic animals manifested a significant rise in arterial pressure upon the reinfusion of the blood which had previously been withdrawn. The average blood pressure ranged between 63 and 64 per cent during the posthemorrhage period of stabilization and with reinfusion rapidly rose to 98 per cent of the control value. (Fig. 1.) Five minutes later it was 91 per cent, ten minutes 86 per cent,

fifteen minutes 83 and twenty minutes 83 per cent of the control value. A substantial increase in coronary sinus flow followed reinfusion of blood in nine of the ten animals. In this group the mean coronary sinus flows were 58 per cent of the control value five minutes, and 64 per cent of the control value twenty minutes, after the hemorrhage. These values one, five, ten, fifteen and twenty minutes after reinfusion of blood were 94, 100, 100, 94 and 94 per cent, respectively.

Hemorrhage and Administration of Fifty Per Cent Dextrose Solution. Each animal in this group exhibited an increase in arterial pressure following the administration of 50 per cent dextrose solution. The posthemorrhage blood pressure averaged between 79 and 82 per cent of the control. The average values one, five, ten, fifteen and twenty minutes after administration of dextrose were 111, 102, 94, 88 and 88 per cent of the control value, respectively. Each dog also underwent a striking increase in coronary sinus flow. The mean values during the period after hemorrhage ranged from 56 to 59 per cent of the control. One, five, ten, fifteen and twenty minutes after the dextrose injection they were 129, 129, 85, 83 and 78 per cent of the control value, respectively.

Hemorrhage and the Administration of Isotonic Saline Solution. Each of the eight animals in this group showed some rise in systemic pressure following the rapid administration of saline solution. The average mean arterial pressure ranged between 71 and 76 per cent during the posthemorrhage period. These values one, five, ten, fifteen and twenty minutes after the infusion were 95, 90, 83, 85 and 82 per cent, respectively. Each animal showed a significant increase in coronary sinus flow following the infusion. The average values during the posthemorrhage stabilization period ranged from 47 to 59 per cent of the control. The same values one, five, ten, fifteen and twenty minutes after the infusion were 150, 118, 106, 100, and 88 per cent of the control.

COMMENTS

The rapid withdrawal of a moderate amount of blood in our experiments was followed by a variable blood pressure response. In two animals no change was observed. In the other twenty-one a reduction in blood pressure occurred which differed in degree from one animal to another. At the one extreme, only a slight fall was noted in a single animal, while at the other, severe hypotension developed in several. In spite of the variations in blood pressure response, all animals exhibited a significant fall in coronary sinus flow. This is in agreement with other studies reported in the literature. Edwards and his associates [3] and later Horvath and his group [4] observed a decreased coronary sinus flow following hemorrhage, as well as a decreased cardiac output and systemic arterial pressure. Horvath observed a gradual increase in coronary flow and systemic pressure with the passage of time following bleeding. Opdyke and Foreman [5] also made similar observations. In one of our animals the coronary sinus flow was a trifle less at twenty minutes than at five minutes after hemorrhage. The others, however, showed a very slight increase in flow during the period of observation.

Following the rapid transfusion of blood into normovolemic animals, only a trivial increase in mean arterial blood pressure was observed. A significant increase in coronary sinus flow was, however, evident.

The hypovolemic animals in our experiments all underwent increase in both arterial blood pressure and coronary sinus flow regardless of whether the withdrawn blood was replaced, an equal volume of isotonic saline was rapidly infused intravenously or 50 per cent dextrose solution was administered. Return of blood pressure and coronary sinus flow following treatment more nearly approached the control values in those animals receiving blood replacement. The administration of dextrose brought about a transient increase in arterial blood pressure above the control level, and both dextrose and saline solution provoked transient, immediate rise in coronary sinus flow to a value substantially above the control, followed by values around the control for the remainder of the period of observation. The increased flow was less well sustained in those animals given 50 per cent dextrose solution. These experiments demonstrate that 50 per cent dextrose solution and large volumes of isotonic saline solution elevate both systemic arterial pressure and coronary sinus flow in hemorrhagic hypovolemia. From numerous other studies and from clinical experience it is obvious that blood replacement constitutes the ideal treatment of hemorrhagic shock. In the present experiments blood replacement brought about very

satisfactory restoration of blood pressure and coronary sinus flow.

SUMMARY

The response of arterial blood pressure and coronary sinus flow to hemorrhage, to blood transfusion and, in moderately hypovolemic animals, to blood replacement, infusion of physiological saline solution and administration of 50 per cent dextrose solution has been determined.

Hemorrhage depresses the blood pressure in about 90 per cent of the animals. It always reduces the coronary sinus flow. Rapid transfusion of blood in normovolemic animals usually brings about a negligible rise in blood pressure and in all animals studied a significant increase in sinus flow.

The moderately hypovolemic animal responds to blood replacement, physiologic saline infusion and administration of 50 per cent dextrose solution with a rise in arterial pressure and coronary sinus flow.

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Chronic Occlusive Disease of the Carotid Arteries with Nondiagnostic or Misleading Pressures on the Retinal Arteries

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THE measurement of pressures on the retinal arteries with the ophthalmodynamometer has been reported to be of value in the diagnosis of occlusive disease of the carotid arteries [*1,6–8,12,14,15–19,21,22,24,25*]. It is generally agreed that ophthalmodynamometry is valuable in the diagnosis of acute thrombosis of carotid arteries. Recently, much attention has been focused on the numerous patients with chronic or slowly progressive occlusions of the carotid arteries, and ophthalmodynamometry has been recommended for the evaluation of their condition. Some investigators have been enthusiastic about the reliability of this procedure [*6,14,15,17,18,22,24,25*] and others have not been [*3,5,9*].

We have reviewed twenty-two case reports of occlusive disease of the carotid arteries, studied both by angiography and by ophthalmodynamometry, from the Neurosurgery Service at the H. C. Moffitt Hospital. In twelve of these cases, the results of ophthalmodynamometric examination* were either nondiagnostic or misleading. The following seven case reports have been selected to illustrate this problem.

CASE REPORTS

Unilateral Subtotal Occlusion of the Internal Carotid Artery. CASE I. Slowly progressive hemiplegia on the right side is exemplified in this case. A fifty-three year old left-handed man was hospitalized. He had an eight week history of a defect in the right visual field associated with hemiplegia of the right side (more severe in the leg than the arm) which was slow in onset but was progressive. The patient had become confused and mildly aphasic.

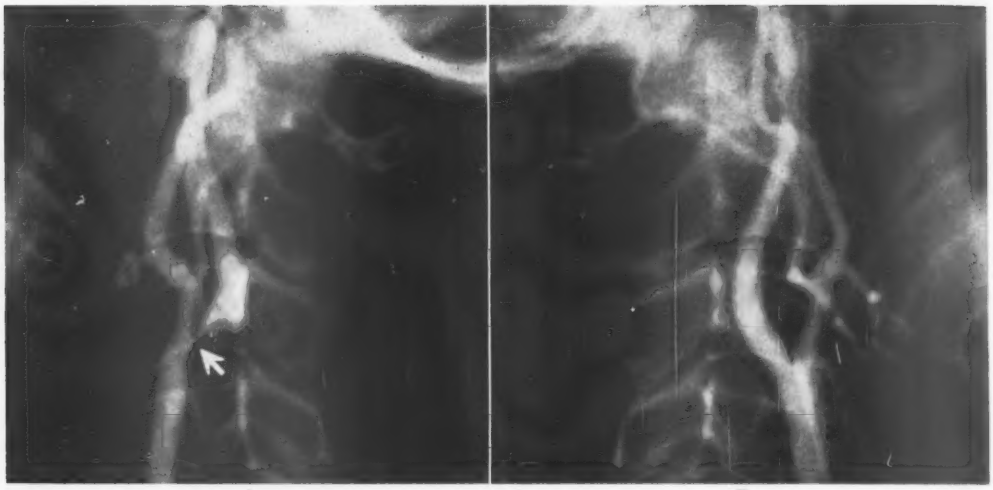
His blood pressure was equal in the two arms (140/90 mm. Hg). He had an aphasic expression, a right homonymous hemianopsia and a right hemiparesis. Compression of the right common carotid artery produced syncope.

Ophthalmodynamometry revealed equal diastolic readings in both eyes. Bilateral arteriograms of the carotid arteries showed almost complete obstruction of the left internal carotid artery. (Fig. 1A and B.)

Comments: Ophthalmodynamometry did not suggest the presence of near total occlusion of the internal carotid artery on the left side near the bifurcation of the carotid artery.

CASE II. Intermittent neurologic symptoms, including blurring of vision is exemplified in this case. A sixty-two year old white man entered the hospital with a one year history of intermittent numbness in the left arm associated with blurred vision which was more noticeable in the right eye than in the left.

* Measurements of pressures on the retinal arteries were performed with the Bailliart ophthalmodynamometer. Only diastolic readings were reported. Examination was performed with the patient in the supine position. The "posture test," suggested by Smith and Cogan [*15*], was used as was the comparison of systolic readings with the ophthalmodynamometer. In our experience, these additional maneuvers did not change the conclusions indicated by the comparison of the diastolic readings alone. The results of ophthalmodynamometry were considered to be nondiagnostic (for practical purposes, equal) when the difference in the two readings was less than 5 mm. for readings below 50 mm. and less than 10 mm. for readings above 60 mm. (such criteria were suggested by Hollenhorst because of the variations found in normal persons and the inaccuracies inherent in the technic [7].



1A 1B

FIG. 1. Case I. A, Injection of radiopaque material into the left common carotid artery. There is a stenotic lesion of the internal carotid artery at the bifurcation. B, Injection into the right common carotid artery.

One month before admission, he experienced a sudden attack of nausea and dizziness associated with blurring of vision in both eyes. The next morning he had total loss of vision in the right eye. He noted flashing lights and colored "snowflakes" in this eye. The vision returned shortly with subsequent awareness of a sector-like visual loss in the upper nasal field.

The blood pressure was equal in the two arms (170/100 mm. Hg). The results of neurologic examination were within normal limits. Ophthalmodynamometry revealed a diastolic reading of 75 mm. in the right eye and 69 mm. in the left eye. Bilateral arteriograms of the carotid arteries disclosed partial occlusion of the right internal carotid artery.

Comments: Although the patient had a history of retinal artery insufficiency on the right side, and the findings verified this, a diagnostic difference in pressure in the retinal arteries was lacking. The measured diastolic reading was higher on the side in which the internal carotid artery was occluded.

CASE III. Sudden hemiparesis of the right side with slow improvement occurred in this patient. A forty-eight year old right-handed white man suddenly experienced hemiparesis of the right side with aphasia one year before admission to the hospital. Improvement was slow but definite.

His blood pressure was equal in the two arms (120/80 mm. Hg.) A bruit was audible over the left carotid artery. Pulsation was diminished. The patient had mild hemiparesis of the right side and aphasia. Electroencephalography demonstrated a dysrhythmia in the right side of the temporal lobe which was exaggerated by compression of the right common carotid artery. Ophthalmodynamometry revealed equal diastolic readings of 55 mm. Bilateral arteriograms of the carotid arteries showed a marked stenotic lesion in the left internal carotid artery. (Fig. 2A and B.)

Comments: The pressures on the retinal arteries in this patient were equal one year after onset of hemiparesis on the right side. Arteriography showed a marked stenosis of the left internal carotid artery.

Unilateral Total Occlusion of the Internal Carotid Artery. CASE IV. Sudden severe hemiparesis developed in the right side of a sixty-five year old right-handed white woman. The hemiparesis, associated with mutism and stupor, occurred during hospitalization; the patient was recovering from amputation of a left lower extremity performed for vascular occlusive disease. Her blood pressure was 160/90 mm. Hg in the right arm and 140/80 mm. Hg in the left arm. Pulsation in the left carotid artery was diminished and a bruit was heard. A hemiparesis of the right side was noted; this was associated with hyperreflexia and Babinski reflex on the right side. The patient had hypesthesia in the right side of her face and the corneal reflex in the right eye was absent.

FIG. 2A. Case III. Injection of radiopaque material into the left common carotid artery. Stenosis of the internal carotid artery is demonstrated.

Ophthalmodynamometry revealed a diastolic reading of 60 mm. in the right eye and 65 mm. in the left. A percutaneous arteriogram of the left carotid artery revealed complete obstruction of the artery intracranially, above the point from which the ophthalmic artery branches. (Fig. 3.)

Comments: The occlusion of the internal carotid artery in this patient was located above the cavernous sinus. The pressure on the retinal artery was slightly higher on the side in which the carotid artery was occluded.

CASE V. A slowly progressive neurologic deficit is exemplified in this case. A fifty-nine year old white man had a four year history of difficulty in reading, a three year history of gradual loss of use of the right hand (spastic hemiparesis) and a two year history of expressive aphasia. One year before admission, the patient had a Jacksonian seizure which started on the right side and progressed to a generalized seizure. Another such seizure occurred just before admission to the hospital.

His blood pressure was equal in the two arms (140/84 mm. Hg). The patient had both expressive and receptive aphasia. A right central facial palsy was present with a right hemiparesis. The deep tendon reflexes on the right side were increased and visual inattention was present on the right side.

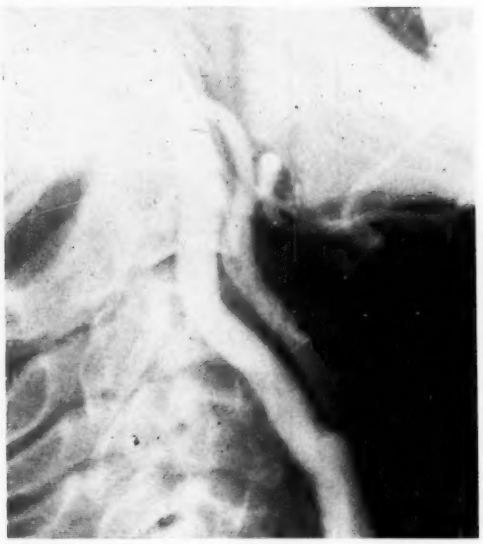


FIG. 2B. Case III. Injection of radiopaque material into the right common carotid artery.

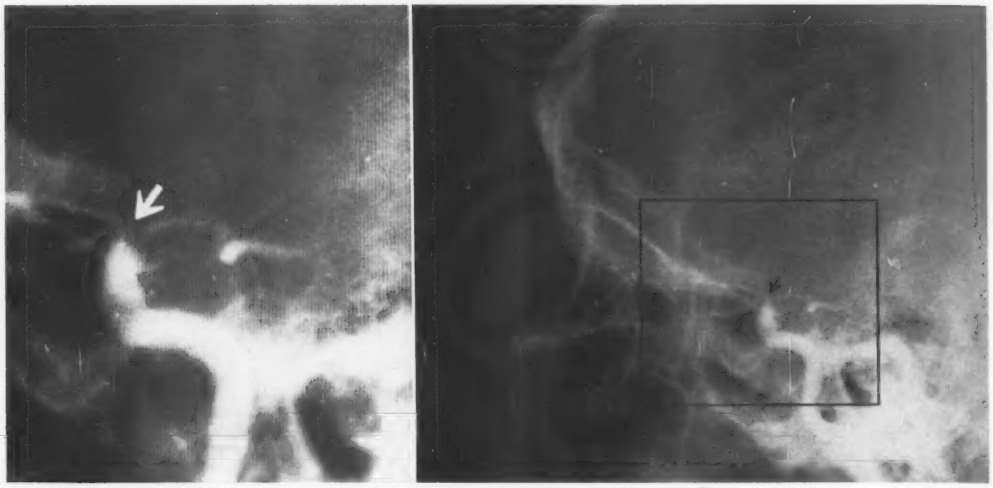
Pulsation in the left carotid artery was diminished; no bruit was audible.

Ophthalmodynamometry revealed a pressure of 90 mm. diastolic in the right eye and 90 mm. diastolic in the left eye. Bilateral percutaneous arteriograms of the carotid arteries showed complete occlusion in the left internal carotid artery. (Fig. 4.)

Comments: Occlusion of the left internal carotid artery was complete. Ophthalmodynamometry was not diagnostic.

Bilateral Total Occlusion of the Internal Carotid Artery. CASE VI. Transient attacks leading to permanent neurologic deficit is presented in this case report. A fifty-nine year old right-handed man had a history of syncopal episodes for many years. These attacks became more frequent seven months before admission and were associated with numbness in the left cheek. Six months before admission, weakness of the left part of his face and hand, associated with slurred speech, developed.

His blood pressure was 180/110 mm. Hg in the right arm and 210/110 mm. Hg in the left arm. The patient had slurred speech but no evidence of true aphasia. The left corneal reflex and the gag reflex were depressed. His strength was diminished in the left arm and hand. The patient had hyperreflexia in the left arm, but the reflexes in the lower extremities were equal. Pulsation in the right carotid artery was diminished but no bruit was heard.



3A 3B

FIG. 3. Case IV. Injection of radiopaque material into the left common carotid artery (A and B). Obstruction at the cavernous sinus with filling of the ophthalmic artery is apparent.

The results of electroencephalography with compression of the carotid arteries were within normal limits. Ophthalmodynamometry readings were 50 mm. on the right and 45 mm. on the left.

FIG. 4. Case V. Injection of radiopaque material into the left common carotid artery demonstrating complete occlusion of the internal carotid artery.

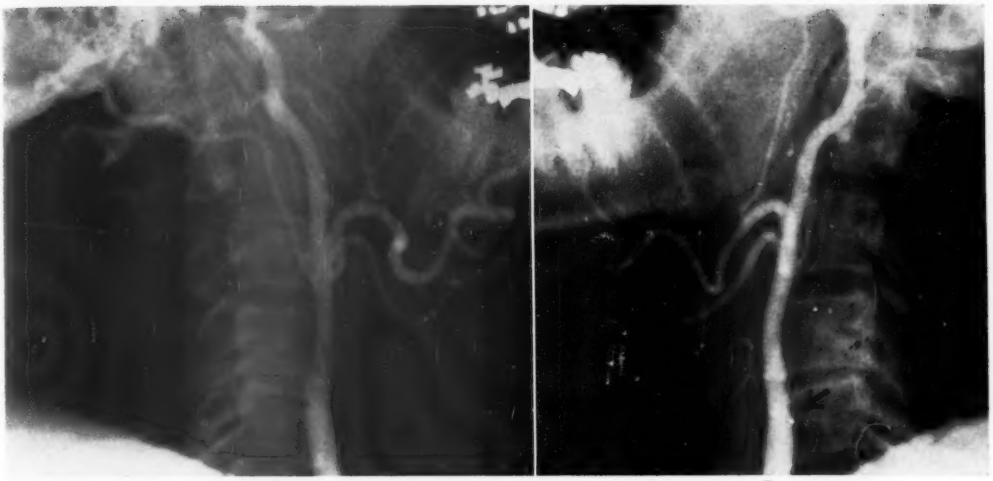
A bilateral percutaneous angiogram of the carotid arteries and a transsternal aortogram were obtained which revealed complete bilateral obstruction of the internal carotid artery. (Fig. 5A and B.) The intracranial portion of the left carotid artery filled from the external carotid artery via the left ophthalmic artery. (Fig. 5C.)

Comments: Ophthalmodynamometry in this case suggested a lesion of the left carotid artery. The results of arteriography showed bilateral complete occlusion of the internal carotid artery. The symptoms and neurologic findings for this patient suggested vertebral basilar artery disease.

Unilateral Total Occlusion of the Common Carotid Artery. CASE VII. Exemplified in this case report are transient neurologic and visual symptoms suggesting vertebral basilar insufficiency.

A sixty-one year old right-handed white man entered the hospital; he had a two week history of transient attacks of dizziness associated with blurring of the left visual field.

The carotid and superficial temporal pulses were diminished on the right side. A bruit was heard over the left carotid and the left subclavian arteries. Manual occlusion of the right carotid artery had no effect, but pressure on the left carotid artery caused paresthesia in the right arm and leg and a hemianopsia in the left eye which



5A 5B

5C

FIG. 5. Case VI. A, Injection of radiopaque material into the right common carotid artery. No filling of the internal carotid artery could be demonstrated. B, there is no filling of the internal carotid artery following injection of radiopaque material into the left common carotid artery. C, external to internal carotid anastamoses are demonstrated after injection into the left common carotid artery.

was more dense in the lower quadrant. His blood pressure was 90/80 mm. Hg in the right arm and 110/70 mm. Hg in the left arm.

Neurologic examination revealed decreased perception of skin writing over the left side of the body and inferior quadrantanopsia in the left eye. Ophthalmodynamometry readings were equal (60 mm.).

The results of angiography by the left carotid and right subclavian percutaneous routes showed total obstruction of the right common carotid artery. The intracranial portion of the right carotid artery filled as a result of injection of the radiopaque material into the left common carotid artery.

Comments: The patient's symptoms and the defect in his visual field suggested vertebral basilar disease. The results of arteriography revealed total obstruction of the right common carotid artery. Pressures on the retinal arteries were equal. The collateral circulation to the

right ophthalmic artery apparently came from the left internal carotid artery.

COMMENTS

The clinical correlation of symptoms, physical findings, pressures on the retinal arteries and angiographic findings is generally not difficult in patients with acute thrombosis of the carotid artery. Ophthalmodynametric examination in such patients usually reflects a general reduction in blood pressure in the involved carotid system [*2–4,10,11,13,20,23*].

The correlation of symptoms and findings in patients with chronic occlusive disease is more difficult. The adaptability of the cerebral vascular system to slowly progressive occlusion of a major extracranial artery by the development of collateral circulation is common knowledge. The retinal artery may be supplied by the external carotid artery of *either* side as well as by retrograde flow in the internal carotid artery of the same side. Symptoms exhibited by such patients may in no way suggest that a carotid artery is occluded. Angiographic studies carried out in such patients often reveal *unexpected* occlusion of a carotid artery. The clinical usefulness of ophthalmodynamometry in the evaluation of patients with long-standing occlusion of a carotid artery seems doubtful to us. Certainly the finding of equal pressures on the retinal arteries gives no assurance that occlusion of a common or an internal carotid artery does not exist; the finding of unequal pressures may be equally misleading. Ophthalmodynamometric readings, therefore, cannot be used to the exclusion of angiography.

SUMMARY

Ophthalmodynamometry has been nondiagnostic or misleading in twelve out of twenty-two cases of angiographically verified occlusion of a carotid artery. Seven illustrative case reports are presented. The diagnostic value of routine measurement of pressures on the retinal arteries in patients with chronic cerebral vascular insufficiency is questioned.

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Assessment of the Patency of the Peripheral Arterial Tree by Electronic Pulse Recordings

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From the Department of Surgery, Indiana University School of Medicine, Indianapolis, Indiana. This work was aided by a grant (PHS research grant H-2035(C-5)) from the National Heart Institute, National Institutes of Health, Public Health Service, and by a contract between the Office of Naval Research, United States Navy, and Indiana University.

A METHOD for predicting accurately, in a preliminary way, the patency of the arterial tree distal to occlusive lesions would be valuable. This has been made possible by the availability of electronic instruments which, through externally applied cuffs, permit the recording of extremely faint pulses such as occur below an obstructed segment of a major artery.

Lax, Feinberg and Cohen in 1956 [1], using their own instrument, studied the upper extremities of patients with generalized vascular disease by means of a cuff adjusted at near-diastolic pressure levels. In 1958 and subsequently [2,3,4], Edwards and his co-workers assessed volume pulses through a commercially available instrument which contains a calibrating device. Quite correctly they utilized a cuff pressure of only 30 mm. Hg which did not cause local circulatory disturbances and also allowed the recording of wave characteristics which otherwise would have been damped out. Pulse waves were usually obtainable in the distal portion of an extremity below a complete obstruction. Although they studied primarily volume pulse differences in organic and spastic vascular disease and after sympathectomy, they noted rather characteristic changes as the recording cuff was moved distally over and beyond an obstruction. Furthermore, they noted that the "poststenotic" features of the wave regressed as the cuff was placed more distally over a patent vessel.

The present study was undertaken with the hope that it would be possible to find a method for classifying pulse waves recorded over patent and diseased vessels distal to areas of arteriosclerotic obliterative disease and to correlate them with arteriograms. This effort proved successful.

MATERIALS AND METHODS

Patients entering the hospital with iliac or femoral arteriosclerotic obstruction were the subjects of this study. Femoral arteriograms were made in all cases and, in some, iliac disease was determined by more proximal arteriograms. "Normal" pulse waves were studied in male subjects ranging in age from twenty to thirty years. Pulse wave studies were also made in several patients without symptoms or signs of peripheral vasculra disease in whom intra-arterial femoarl or iliac pressure pulse recordings were available.

Pulse recordings were made at each of six levels by carefully fitting a two inch wide cuff with an inelastic backing around the lower extremity. These levels were designated high thigh, mid thigh, low thigh, high calf, calf and ankle, respectively. The cuffs were connected pneumatically with an Infratron "pulse oscillograph"* and were recorded on a Sanborn twin viso cardiette attenuated to ×4 through the electrocardiographic preamplifier. Volume changes were calculated according to the formulas suggested by Edwards for mean pulse deflection (D), and rate of systolic rise (SS). These values were then expressed in terms of $mm.^3$ and $mm.^3$ per second, respectively. Pulse wave changes were later correlated with known disease areas following subsequent arteriograms. All tracings were made after

* Obtained from Biophysical Electronics, Inc., Great Neck, N. Y.

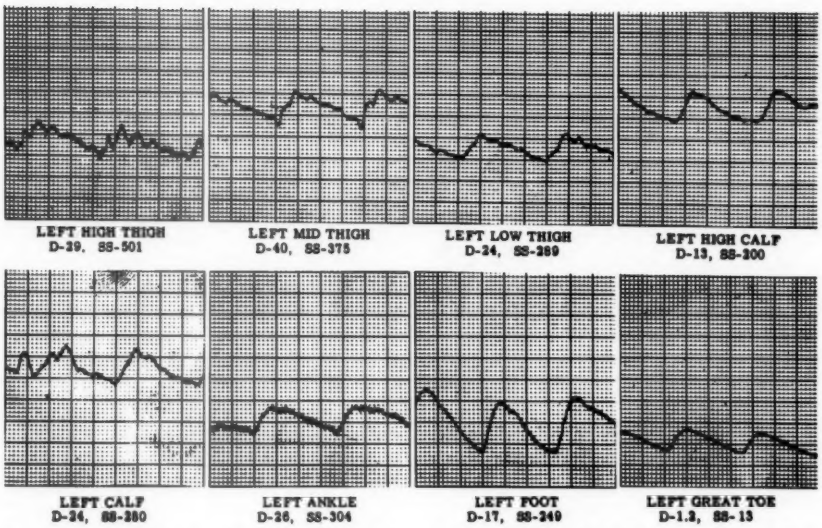

FIG. 1. Case 18. Pulse tracings show a slow onset of the peak at the high thigh level, large vibrations, loss of the dicrotic notch and low amplitude of the wave. These changes gradually regress at lower levels. This tracing was interpreted as indicating severe iliac disease with a patent distal tree.

twenty minutes of supine rest in a constant temperature room with the patient comfortably relaxed. A room temperature of 75°F. proved the most satisfactory.

GENERAL OBSERVATIONS

The pulse waves of five normal subjects were similar at high thigh levels to the familiar femoral pressure pulse waves seen when recorded from an intra-arterial needle. The interval between the initial rise of the ascending limb and the onset of the peak varied between .14 and .20 second at the high thigh level. The onset time of the peak showed progressive decrease at lower levels and ranged between .08 and .12 second at the ankle. Increases of no more than .02 second occurred over some areas, particularly the calf. The dicrotic notch appeared progressively lower on the descending limb in all cases as the cuff was placed more distally and finally began to appear again after the descending limb had returned to "base line" at some level in the lower leg.

A striking similarity was noted between the extra-arterial and the intra-arterial pulse waves in three patients without signs or symptoms of peripheral vascular disease. The principal difference was a longer onset interval of the peak in the extra-arterial pulse wave. This difference was .04, .06 and .10 second in the three cases, respectively. It was my impression that a factor of transit time of the pulse through the soft tissue created this time difference.

Twenty-five extremities of twenty-two patients with a wide range of arteriosclerotic involvement were studied. These changes were noted below obstructions in major vessels: vibrations on the ascending and descending wave limbs, lowered volume and amplitude, increased interval between wave and peak onset, development of a higher shoulder on the ascending limb or "rounding" of the peak, slower descent of the descending limb, loss or severe diminution of the dicrotic notch and increasing irregularity between successive waves.

At the high thigh level below an iliac obstruction, a uniformly characteristic pulse wave demonstrated loss of the dicrotic notch usually associated with severe changes in wave contour. Below obliteration or block of any length of the superficial femoral artery a delay in peak onset of .04 second or greater was nearly a uniform finding and marked contour changes were present in all cases. Because of low pulse volume and varying degrees of wave distortion existing below one or more areas of proximal obstruction, the marked changes described here could not be demonstrated

FIG. 2. Case 18. The retrograde iliac arteriogram demonstrates marked narrowing of the common iliac artery. The left femoral arteriogram showed a normal distal tree. A successful iliac thromboendarterectomy was performed.

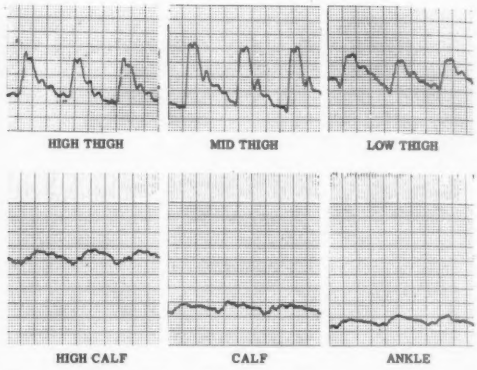

FIG. 3. Case 25. The pulse tracing shows marked change in wave contour at high calf level indicative of low femoral obstruction. Increased irregularity of the wave at calf level suggests disease around the low popliteal-upper tibial area. The loss of abnormal vibrations, coupled with a tendency for the wave to regain a sharp tip in the ankle tracing, was interpreted preoperatively as indicative of lower tibial patency.

easily below areas of tibial disease. It was noted, however, that any wave recorded over an area where vessels were patent had a sharp peak of some degree, provided that the area was not immediately below an obstruction. In some cases this would be no more than a sharp tip on an otherwise rounded and flattened wave.

In general, vibrations were noted with the cuff over a patent arterial segment immediately below an obstruction. More distal to the obstruction, vibrations tended to become smaller if the vessel remained patent, stable or increased with irregularity of the vessel and damped out completely over occluded vessels.

Good correlation of pulse wave changes to the existing disease was made at all arterial levels except the mid and upper portion of the superficial femorals. In all cases the appearance of the marked pulse volume reduction observed correlated well with the calculated volume change. Calculation of "mean pulse deflection" and "systolic slope" at high thigh levels showed a definite grouping of decreased values in the extremities with known iliac blocks. Percentage reduction of these values below more distal obstructions provided less definite differentiation from those of controls and use of these values proved unreliable in the lower leg.

HIGH THIGH PULSE WAVES IN ILIAC DISEASE

The study included sixteen instances of iliac or aorto-iliac block or severe partial obstruction proved by arteriographic study or operative findings. The pulse wave changes in these patients appeared to fall into one of two patterns, both with loss of the dicrotic notch. In nine instances a wave markedly reduced in volume and amplitude had a slowly rising ascending limb and multiple spiked vibrations throughout the length of the wave (Fig. 1). The retrograde iliac arteriogram in one patient is illustrated. (Fig. 2.) These nine patients had severe disease, and in six, complete iliac or aorto-iliac obstruction was present. Peak onset time in these waves tended to be .2 second or greater. In the six remaining extremities with known iliac disease there was a more steeply rising ascending limb, slightly greater volume and absence of a dicrotic notch; the degree of obstruction in these patients ranged from moderate to severe. Onset interval of the peak was slightly shorter. In one extremity below known iliac disease the wave had a very small volume with peak onset interval of only .08 second and what appeared to be a

FIG. 4. Case 25. The femoral arteriogram shows a low superficial femoral block, a patent popliteal, severe narrowing at the junction of the popliteal with the tibials and well visualized lower tibials. A lumbar sympathectomy was performed.

dicrotic notch. Of the remaining nine extremities in patients without proved iliac obstruction, four showed absence of a dicrotic notch at the high thigh level and two of these four patients gave a history of thigh claudication suggesting iliac disease.

LOW THIGH AND HIGH CALF PULSE WAVE STUDIES IN LOWER SUPERFICIAL, FEMORAL AND POPLITEAL DISEASE

Pulse changes in lower superficial femoral obstruction tended to appear at the low thigh level and tended to reach a maximum at the high calf level. Fourteen patients had readily recognized marked wave contour changes at one or both of these levels. Eleven had definite increase of peak onset time, two had increased peak onset time in some but not all waves at one level and one had no delayed peak onset. These fourteen patients and one other with an extremity with no pulse wave at any level below the high thigh comprised the group in which there were fifteen instances of superficial femoral or low femoral block. Three instances

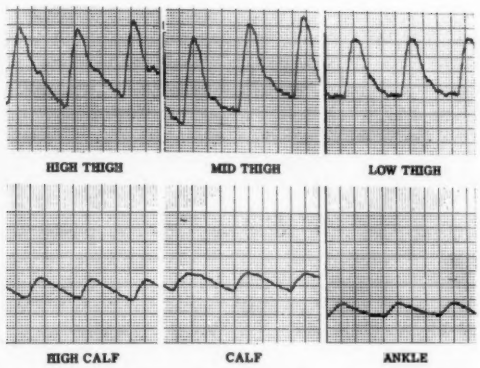

FIG. 5. Case 21. The pulse tracing shows marked change in wave contour from low thigh to high calf level indicating superficial femoral obstruction. Despite regular, well formed pulse wave at levels below the knee, failure of a sharp peak to reform in the pulse wave is indicative of severe distal disease.

of arteriographically evident, lower superficial femoral irregularity without obstruction could not be recognized on the basis of pulse wave findings.

In two extremities with severe popliteal disease below a patent superficial femoral there was a definitely delayed peak onset at high calf level without severe contour change. Marked popliteal disease occurring below a femoral block could be distinguished in seven of eight instances where a pulse wave was present at low thigh level by the loss of a high calf wave in two, and by complete loss or decrease in the sharpness of the peak in five.

Figures 3 through 10 illustrate pulse wave studies and arteriographic observations in four limbs and demonstrate the value of the method in assessing the state of the vascular tree distal to the femoral or popliteal obstruction.

CALF WAVE STUDIES IN LOWER POPLITEAL AND UPPER TIBIAL DISEASE

In twenty-two of the twenty-five extremities studied, a pulse wave was present just above the calf level. (Fig. 3.) In two calves the pulse disappeared at this level. In one of them there was severe popliteal and tibial disease with an intervening block. In the other there were normal vessels below an aorto-iliac obstruction. In four calves the sharp pulse peak was completely lost. These extremities had diseased vessels with severe or complete popliteal-tibial block. In three, peak sharpness was decreased

FIG. 6. Case 21. The femoral arteriogram shows narrowing of the superficial femoral, obstruction of the distal superficial femoral and a somewhat narrow popliteal. The tibials do not visualize except for 1 cm. of each while one long collateral opacifies a little farther down the leg. A lumbar sympathectomy was performed.

relative to high calf tracings and the tibials were all irregular and narrowed. In eleven, peak sharpness was stable relative to high calf level tracings. Seven of them had good tibial patency, in two some disease was present and two were definitely too diseased to permit a reconstructive operation for a more proximal block. In two, peak sharpness was increasing. In both, tibial patency was present but in one operative re-establishment of blood flow could not be undertaken because of a tiny threadlike popliteal artery.

ANKLE PULSE WAVE STUDIES IN MID AND LOWER TIBIAL DISEASE

In twenty of the twenty-five extremities, a pulse was present above the ankle. Disappearance of the pulse wave was correlated with severe tibial irregularity and narrowing in two. It occurred with relatively good tibials below an aorto-iliac block in one instance. In three, absence of a sharp peak correlated with mid or upper tibial block or narrowing. (Fig. 5.) In one extremity with peak sharpness decreasing relative tracings at the calf level, all the tibial

TABLE 1

PULSE WAVE CRITERIA FOR PREDICTION OF DISEASE OR PATENCY IN ARTERIAL SEGMENTS OF THE LOWER EXTREMITY

Level of Recordings	Pulse Wave Changes	Significance
High thigh..	Loss of dicrotic notch, or the above plus severe contour changes	Severe iliac disease
Low thigh, high calf..	Severe contour changes usually with delay in onset of peak by 0.04 second or more over mid thigh	Femoral block
High calf...	Severe contour changes of femoral block plus loss or decreasing sharpness of, the peak	Marked popliteal disease below femoral block
High calf...	Delay in onset of the peak and loss or decreasing sharpness of the peak without severe contour changes	Marked popliteal disease with patent femoral above
Calf.....	Loss or decreasing sharpness of the peak	Disease in region of origin of tibial arteries
	Stable or increasing sharpness of the peak	Patency in region of origin of tibial arteries
Ankle.....	Loss of sharpness or decreasing sharpness of the peak	Disease of mid or lower tibials
	Stable or increasing sharpness of the peak	Patency of mid and lower tibials

vessels were irregular and poorly filled. (Fig. 7.) In three, peak sharpness was stable. All had patent lower tibial vessels. In nine, peak sharpness increased at the ankle level. (Fig. 9.) In seven of them the lower tibials were patent, while in one there was a well visualized peroneal only, and in another there was a well visualized but slightly irregular posterior tibial only.

SUMMARY OF PULSE WAVE CORRELATION WITH ARTERIAL DISEASE

It can be seen from Tables I, II and III that the diagnosis of severe iliac disease, superficial femoral block and popliteal disease can be made reliably from pulse wave changes, utilizing the criteria established. It would appear at first glance that there was some error in predicting tibial disease. It must be remembered, however, that some of these vessel segments

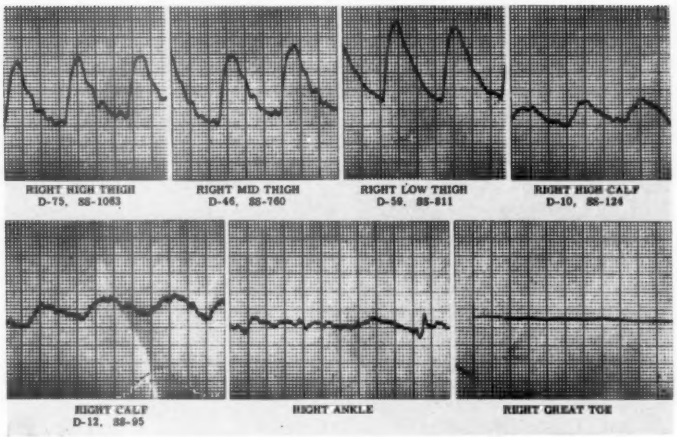

FIG. 7. Case 3. The right lower extremity tracing shows marked changes beginning at the high calf level, including delay in the onset of the peak, irregular vibrations and a tendency for the wave to lose its sharp peak. These changes become more marked at the calf and ankle levels. These were interpreted as indicating a superficial femoral arterial obstruction with severe disease in the distal tree.

erroneously predicted to be patent were only moderately diseased. Furthermore, if pulse-tracing evidence of occlusive disease either in the upper or lower tibial segments is interpreted as inadequate runoff for proximal grafting or thromboendarterectomy, only one diseased and two patent tibial systems were incorrectly predicted. The two patent tibial systems were in extremities below an aorto-iliac block. The marked irregularity, low volume and difficulty in even being certain a wave was present at the thigh levels give a clue to the unreliable nature of this type of wave. On the other hand, the one extremity with the diseased tibial system in which patency was predicted had a uniformly diseased distal tree below an iliac block with visualization in the lower leg of only the posterior tibial artery on arteriographic study. With encouragement from the pulse wave findings, an iliac thromboendarterectomy was performed in this instance. Gratifyingly enough, there was successful restoration of the posterior tibial pulse postoperatively.

Of eleven reconstructive procedures carried out, there were two acute failures. It is of particular interest that severe distal disease was predicted in both of these patients. In Table II one patient (Extremities, 11) was shown to have a considerable peak delay at the high calf level. This corresponded to only a very slight upper popliteal narrowing on the arteriogram and to a nearly complete occlusion from a plaque when this segment was examined following amputation.

FIG. 8. Case 3. The right femoral arteriogram shows a poorly filled upper superficial femoral and a complete block in the lower portion. There is narrowing of the upper anterior tibial and all are irregular. A lumbar sympathectomy was performed.

TABLE II

CORRELATION OF PULSE WAVE PREDICTION WITH KNOWN AREAS OF ARTERIAL DISEASE*

Extremities	Aorto-iliac or Iliac	Femoral		Marked Distal Popliteal		Tibials				Tibials Combined	
		Distal	Complete Block	Femoral Block Above	No Femoral Block Above	Upper		Lower		Distal	Patent
						Distal	Patent	Distal	Patent		
1	+	...	+	...	...	0	...	+	...	+	...
2	nk	...	+	+	...	(−)	...	(−)	...	(−)	...
3	nk	...	+	...	...	+	...	+	...	+	...
4	nk	...	+	...	...	...	+	...	+	...	+
5	+	...	+	0	...	+	...	(−)	...	+	...
6	+	...	(−)	...	...	...	(−)	...	(−)	...	(−)
7	+	0	...	...	+	+	...	...	+	+	...
8	+	...	...	...	...	...	+	...	+	...	+
9	?	...	+	...	...	+	...	+	...	+	...
10	+	...	+	+	...	+	...	0	...	+	...
11	+	...	...	...	+	...	+	...	+	...	+
12	+	...	...	...	...	...	0	...	(−)	...	0
13	+	0	...	...	...	...	+	...	0	...	0
14	+	...	...	...	...	...	+	...	+	...	+
15	+	...	+	+	...	0	...	+	...	+	...
16	nk	...	+	+	...	0	...	+	...	+	...
17	nk	...	+	+	...	+	...	0	...	+	...
18	+	0	...	...	...	0	...	0	...	0	...
19	+	...	...	...	...	...	+	...	+	...	+
20	+	...	...	...	...	...	+	...	+	...	+
21	nk	...	+	+	...	0	...	+	...	+	...
22	nk	...	+	...	...	+	...	...	+	+	...
23	+	...	...	...	...	...	+	...	+	...	+
24	nk	...	+	+	...	(−)	...	(−)	...	(−)	...
25	nk	...	+	...	...	+	...	...	+	+	...

* +, correctly predicted; 0, incorrectly predicted; (−), wave disappeared at higher level; nk, not known.

TABLE III

SUMMARY OF PULSE WAVE CORRELATION WITH KNOWN AREAS OF ARTERIAL DISEASE

Findings	Aorto-iliac or Iliac	Femoral		Popliteal Marked Disease		Tibials				Combined	
						Upper		Lower			
		Narrowing	Complete Block	Below Femoral Block	Not Below Femoral	Narrowing	Patent	Narrowing	Patent	Narrowing	Patent
Correct prediction...	15	0	14	7	2	8	8	6	10	12	7
Incorrect prediction..	0	3	0	1	0	5	1	3	1	1	2
Wave absent at more proximal level.....	...	...	1	...	...	2	1	3	2	2	1
Questionable prediction.....	1	...	...	...	...	...	...	...	...	...	...
Total.....	16	3	15	8	2	15	10	12	13	15	10

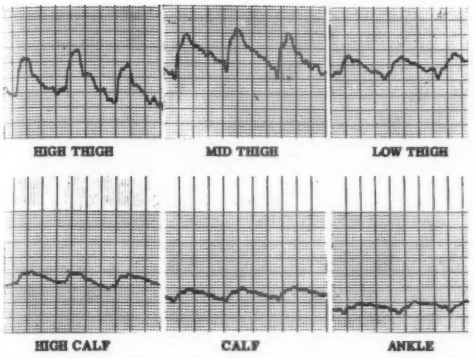

FIG. 9. Case 4. Pulse tracings of the left lower extremity begin to undergo wave contour changes at low thigh level, including noticeable delay in the onset of the peak and some irregular vibrations. These changes begin to disappear at high calf level. The wave at calf level has a sharp tip and this becomes better defined at the ankle level. The tracing was thought, preoperatively, to indicate superficial femoral obstruction with evidence of a patent distal tree.

FIG. 10. Case 4. The left femoral arteriogram shows nonvisualization of the upper three-fourths of the superficial femoral. The popliteal is patent. The posterior tibial and peroneal are irregular and are visualized to the ankle. A posterior tibial pulse was successfully restored following a superficial femoral thromboendarterectomy.

COMMENTS

The results of this study would indicate that reliable estimation of distal arterial patency in the presence of proximal disease is possible from pulse waves recorded from externally placed cuffs. The essential features of this method are a sensitive electronic transducer and the use of very low pressures in the recording cuff.

The findings in this study of pulse wave changes below iliac and femoral obstruction are in agreement with those observed by Edwards and his associates [3]. It has long been known that such changes can be seen in intra-arterial tracings taken from large vessels below areas of stenosis. For example, some of our tracings taken at high thigh level and below iliac occlusion are almost identical with those obtained by Katz [5] in his studies of experimental aortic stenosis in the dog. Although the exact mechanism of the observed vibrations is not clear, they are observed in intra-arterial tracings as well as in the extra-arterial pulse waves. With complete obliteration of the main vessels vibrations would be expected to dampen out quickly, as the observations here have demonstrated is the case.

The progressive decrease in peak onset time at more distal levels observed in normal subjects would appear to be due to both intra- and extra-arterial factors. Inspection of pressure pulse waves from femoral and dorsal pedal arteries in a study by Remington and Wood [6] reveals a definite but slight decrease in peak onset time in the dorsalis pedis. If the average increase of extra- over intra-arterial peak onset time observed in the three subjects studied here, which is similar to that estimated from data given by Lax and his colleagues [1], is subtracted from the usual peak onset obtained by cuff at the high thigh level, a value similar to that at the ankle is obtained. In other words, both intra-arterial peak augmentation and decreasing extra-arterial soft tissue mass at more distal levels account for the decrease in peak onset time observed. Thus the likelihood that a definite increase in onset time of the peak is due to arterial obstruction is apparent.

The results obtained show that reliable estimation of arterial patency in the lower extremity can be obtained for all levels other than the upper and mid superficial femoral. Presumably, the difficulty in this area stems from the patency of the deep femoral and large collateral vessels.

The clinical usefulness of the method with patients with arteriograms showing a ques-

tionably adequate distal tree was suggested by three cases in particular. On one patient with a badly diseased arterial tree by arteriographic study but no evidence of segmental narrowing from pulse wave studies, a successful iliac thromboendarterectomy was performed. In those patients treated by reconstructive procedures, a serious arterial disease was predicted by preoperative pulse wave findings only in the two cases which ended in acute failure and amputation. In one this evidence was lacking from arteriographic study. The results of pulse wave analysis, in admittedly a rather small group of patients, suggests that they may prove valuable in considering the possibility of operative reestablishment of blood flow through or around obstructed arterial segments.

SUMMARY

1. The use of electronic pulse wave studies in predicting the patency of the distal arterial tree in arteriosclerotic obliterative disease is described.

2. Similarity of these pulse waves to arterial pulse tracings suggest that the alterations observed in diseased limbs are valid reflections of the patency of the vessel under examination.

3. Reliability of this method is demonstrated by the generally accurate correlation with distal arteriograms.

4. The method would appear to be clinically useful as a supplement to arteriography.

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Prophylactic Use of Procaine Amide (Pronestyl) in Ventricular Fibrillation During the Production of Intracardiac Defects in Dogs under Hypothermia

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THE advances obtained in cardiac surgery during the last decade have been remarkable, mainly due to the effort of scientists working on experimental surgery. The production of cardiac defects, the study of their physiology and their correction have been a wonderful tool through which the cardiac surgeon obtains knowledge and dexterity.

With the advent of open heart surgery, most of the congenital defects found in man can be reproduced experimentally. Using hypothermia the surgeon has around eight minutes to work safely in a heart after total occlusion has occurred. This time would be enough for the production and/or correction of many defects if this technic were not accompanied by a high incidence of ventricular fibrillation, a complication which is recognized to carry a tremendous mortality.

The hypothermic heart is more susceptible to fibrillation than the normothermic heart, but there is no general agreement of the factors which influence fibrillation during cooling. Of apparent importance is the surgical manipulation of the heart. The prevention of ventricular fibrillation is of greater importance than its correction.

The production of intracardiac defects has been disappointing in our laboratory because of the high operative mortality due to ventricular fibrillation. The manipulations during the performance of interatrial septal defects with mitral stenosis (Lutembacher syndrome) are highly fibrillatory. Many drugs have been tried to prevent this arrhythmia and the controversial effects have been reported in the literature. The injection of procaine in the sinoauricular node has been used with beneficial results. Procaine amide (Pronestyl®) was selected in our experimental work because of its pharmacologic actions. Contrary to procaine this drug is not readily hydrolyzed by the plasma enzymes; thus the level persists for several hours. The action appears to be chiefly a depression of the excitability of all cardiac muscles, preventing multiple firing and lowering conduction. The contractility is slightly increased and the atrial and ventricular thresholds are raised.

METHODS

Fifty-seven mongrel dogs weighing 12 to 20 kg. were used in our work. Pronestyl was administered to nineteen of them, and the remaining thirty-eight were the controls. The dogs were anesthetized with intravenous Nembutal® and respiration was maintained by means of an endotracheal tube connected to a mechanical respirator utilizing 100 per cent oxygen. Cooling was achieved by immersion in an ice bath until the rectal temperature went down to 31°C.

Under aseptic technic a right thoracotomy was performed through the fourth intercostal space. The azygous vein was ligated and the pericardium opened. Tapes were placed around both venae cavae and a vascular clamp was

TABLE I
RESULTS IN NINETEEN DOGS THAT RECEIVED PRONESTYL

Result	No.
Fibrillation	2(10.5%)
Operative deaths	1
Postoperative deaths	5
Survival more than four weeks	13

TABLE II
RESULTS IN THIRTY-EIGHT DOGS THAT DID NOT RECEIVE PRONESTYL

Result	No.
Fibrillation	25(65.8%)
Operative deaths	33
Survival after four weeks	5

passed around the aorta. Prior to the occlusion, Pronestyl, 10 mg. per kg. of body weight, was injected directly into the right atrium except in the dogs used as controls. We waited three minutes before undertaking any manipulation of the heart. After occlusion the right atrium was opened longitudinally. At the site of the ostium secundum a defect measuring about 1.5 cm. was created by circular excision with scissors. Through this opening, the mitral valve was easily visualized and a silk stitch was taken to approximate its anterior commissure producing a stenosis. Following the completion of the defect, the air was removed from the left ventricle and the atria, the clamp in the aorta, and the tapes around the venae cavae were released, and the atrial incision closed with a continuous No. 5–0 silk suture. The pericardium was left partially open. A rubber tube was inserted into the chest for aspiration of air and fluid and removed after four to six hours; the chest wall was closed in layers. At this stage, the temperature had usually drifted to around 28°C. and rewarming was carried out by immersion in warm water. When fibrillation occurred, management consisted of manual massage, the administration of intracardiac epinephrine to restore tone and serial electric shocks.

RESULTS

Of nineteen dogs that received Pronestyl only two had cardiac fibrillation, an incidence of 10.5 per cent. One was easily resuscitated, and the other died of massive air embolism of both coronary arteries. During the first and third postoperative days five died of atelectasis, hemothorax and pulmonary embolism. Thirteen survived more than four weeks. Among the causes of late death were congestive failure, subacute bacterial endocarditis and empyema. (Table I.)

Of the thirty-eight dogs used as controls, twenty-five had fibrillation, an incidence of 65.8 per cent. Of these, five were resuscitated. Six dogs died of ventricular fibrillation during the rewarming period, for a total of thirty-three operative deaths. Only five dogs survived more than four weeks. (Table II.)

COMMENTS

Although we do not know the exact mechanism of action of Pronestyl on the hypothermic heart, the data presented in this study show that the administration of the drug has been beneficial in the prevention of ventricular fibrillation during the production of intracardiac defects in hypothermic dogs. It is our belief that the short action of Pronestyl on the heart was responsible for the protection during surgical manipulations.

In the dogs that received Pronestyl not a single case of fibrillation was observed during the rewarming period, whereas in the control group this occurred in five instances.

CONCLUSION

The experimental production of intracardiac defects under hypothermia is associated with a tremendous operative mortality due to the high incidence of ventricular fibrillation. Of the animals that survived the surgical procedures, the number that lived long enough to be used in further studies was not significant.

The administration of Pronestyl in doses of 10 mg. per kg. of body weight prevented ventricular fibrillation; thus the mortality is decreased markedly and the survival rate considerably augmented.

SUMMARY

Intracardiac defects were produced in fifty-seven dogs under hypothermia. The administration of Pronestyl is apparently of help in

preventing ventricular fibrillation in the arrested, hypothermic heart when submitted to surgical manipulations.

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Types of Renal Hypertension Correctible by Surgical Therapy

CORRELATION OF RENAL ARTERIOGRAPHY AND PATHOLOGY

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INCREASING numbers of correctible unilateral renal lesions which produce hypertension are being discovered by individual function tests and renal arteriography [1–3]. These lesions are (1) unilateral renal parenchymal disease and (2) major arterial lesions limiting blood flow to one or both kidneys. Pyelonephritis and renal hypoplasia are among the most frequent causes of unilateral parenchymal disease associated with hypertension. The vascular abnormalities known to be associated with hypertension are the following: partial occlusion of a renal artery by arteriosclerosis; coarctation of the abdominal aorta; renal arteriovenous fistula; aneurysm of the renal artery; and neoplastic encroachment upon a renal artery.

Each of the following case reports illustrates a different correctible lesion and describes briefly the surgical technic employed to correct it. Methods for the detection of lesions responsible for hypertension are discussed.

CASE REPORTS

CASE I. T. F., a fifty-nine year old man, entered the Barnes Hospital because of syncope and severe headaches. He had been treated symptomatically for hypertension for four years. Medical therapy which included antihypertensive drugs eventually failed to control his symptoms. His blood pressure had been between 249/120 and 200/100 mm. Hg for six months.

Physical examination revealed his blood pressure was 200/110 mm. Hg and his pulse 76 per minute. A flame-shaped retinal hemorrhage in the right eye was unassociated with papilledema. The heart was slightly enlarged with a normal sinus rhythm. No other physical abnormalities were found. His hemogram, blood electrolyte concentrations, serum transaminase values and urinary catechol amines were within normal limits. The urine contained a trace of albumin and 10 to 12 red blood cells per high power field (×43) and was sterile. The electrocardiogram indicated left ventricular enlargement. The excretion by both kidneys of the intravenously administered pyelographic contrast media was delayed. Excretion of phenolsulfonphthalein was 15 per cent in fifteen minutes and 60 per cent in two hours.

The malignant trend in the hypertension of this patient and the failure to respond satisfactorily to adequate medical treatment were indications for renal arteriography. The percutaneous renal arteriograms (Fig. 1) demonstrated a narrowing of the left renal artery near its origin and delay in arterial filling of the left kidney.

The splenic artery was large, soft and pliable. The spleen was removed and the end of the splenic artery anastomosed to the distal end of the renal artery after its ligation proximally. This procedure was elected because it avoided the necessity of clamping the extensively diseased aorta.

Postoperatively, the blood pressure fell to 150/80 mm. Hg within four days, and at two weeks the blood pressure was 140/80 mm. Hg. The postoperative renal angiogram (Fig. 2) demonstrates the splenorenal arterial shunt. It has been ten months since restoration of left renal blood flow; the patient remains normotensive.

CASE II. J. G., a forty-one year old man, was admitted to the Barnes Hospital because of severe headaches and disturbances in vision. Five months before, the patient had a sudden pain in the right side of the abdomen accompanied by nausea. He underwent an appendectomy without complications. At that time, his blood pressure was normal.

For six weeks the patient had experienced pain in the left side of both the chest and abdomen. Ten

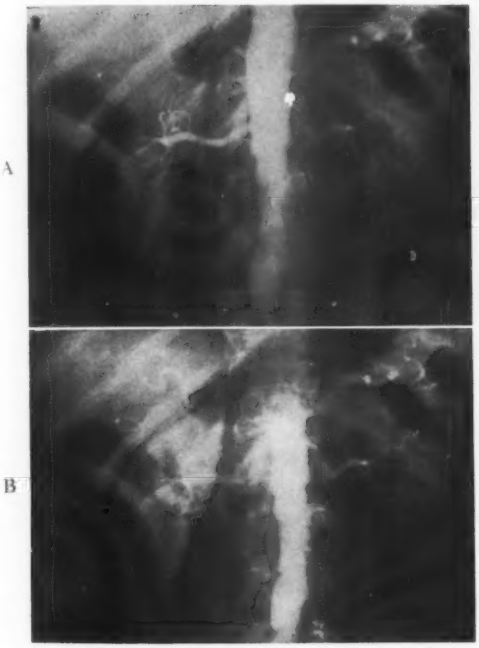


FIG. 1. Case 1, partial obstruction of left renal artery (two roentgenograms from a series of twenty). A, the left renal artery is narrowed near the aorta (arrow) and the aorta is irregular due to arteriosclerosis. B, the decreased blood flow rate to the left kidney is confirmed by a later film which shows the nephrogram of the right kidney in the venous phase at the same time the left kidney remains in the arterial phase due to slow filling of the arteries.

days before entering the hospital, the patient fainted and noticed weakness of the left arm and leg.

Physical examination revealed his blood pressure was 220/130 mm. Hg in both arms. Scattered retinal exudates were present without papilledema. The heart was not enlarged. The urine contained albumin and 1 to 5 white blood cells per high power field. The urinary specific gravity was 1.017 and became 1.023 after ten hours of fasting. The phenolsulfonphthalein excretion was 20 per cent in fifteen minutes. The intravenous pyelograms were considered normal. The creatinine clearance was 92 ml. per minute for both kidneys, and the urinary concentration for catechol amines was normal.

Percutaneous transfemoral aortography [4] was performed because of the sudden onset of severe hypertension and the possibility of renal infarction. Infarct of the upper pole of the right kidney was found, and nephrectomy was performed. The patient's blood pressure became 150/90 mm. Hg after operation; his symptoms were relieved. He has remained well the past two years.

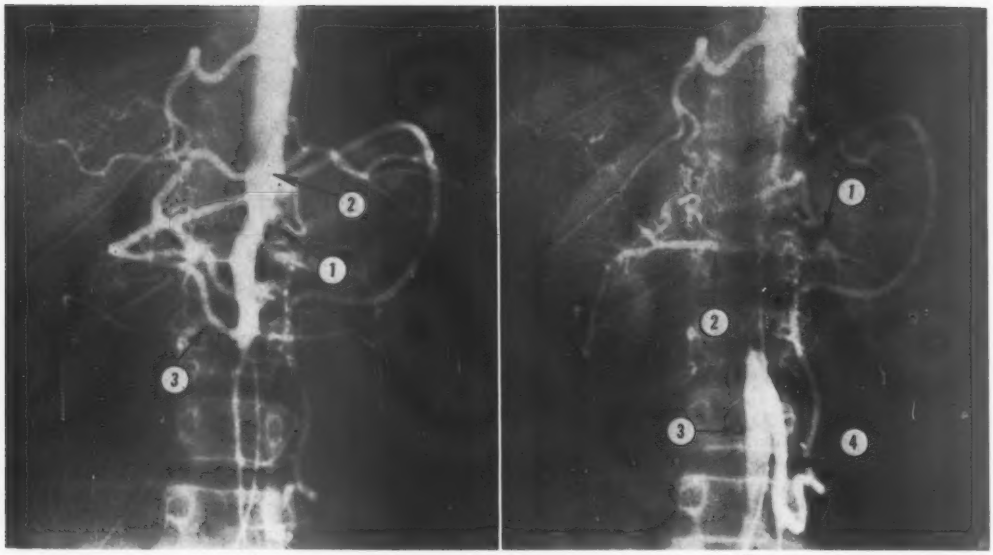
FIG. 2. Case 1, postoperative spleenorenal arterial shunt. Arrows indicate (1) spleenorenal arterial anastomosis and (2) proximal ligated part of left renal artery (one month after operation).

CASE III. J. P. [5], a twelve year old girl, was examined in the Neurosurgical Clinic of Barnes Hospital for severe headaches, weakness of the right upper and lower extremities and vomiting. The patient's blood pressure was 220/160 mm. Hg in both upper extremities and bilateral grade 3 papilledema was present. Fine movements of the right hand were impaired, but the neurologic examination was otherwise normal. The neurologic consultant found no evidence of primary intracranial disease.

Normal renal excretory systems were demonstrated. The urinary catechol amine concentration was normal. After intravenous injection of 5 mg. of phentolamine (Regitine®), the systolic blood pressure decreased 30 mm. Hg.* Antihypertensive drugs were administered; there was no significant change in blood pressure.

The presumptive diagnosis was pheochromocytoma, but none was found at operation. Subsequently, retrograde aortography showed coarctation of the abdominal aorta between the superior mesenteric and renal arteries, causing narrowing of the left renal artery and poststenotic dilatation. (Fig. 3, arrows 1 and 2.) The aorta and renal arteries were exposed through a thoraco-abdominal incision. (Fig. 4.) A fibrous cord, about 2 mm. in diameter, replaced the abdominal aorta below the superior mesenteric artery. No pulse was palpable

* This was subsequently found to be a false positive due to administration of rauwolfia drugs.



3A 3B

FIG. 3. Case III, coarctation of abdominal aorta. A, arrows indicate (1) enlarged superior mesenteric artery arising from (2) cone shaped coarctation and the (3) middle colic artery. B, a later film shows (1) left and (2) right renal arteries and (3) the terminal abdominal aorta filled by the (4) inferior mesenteric artery.

in either renal artery although the kidneys appeared normal. A thrill was felt near the origin of the left renal artery. An aortic bifurcation homograft was employed to bypass the coarctation. The aortic portion of the graft was anastomosed to the lower thoracic aorta, one iliac limb of the graft to the lower abdominal aorta and the other to the left renal artery. (Fig. 5.) The pulse rates in the lower extremity improved postoperatively, but the blood pressure remained elevated (170/130 mm. Hg).

Three months later intravenous pyelography showed less opacification of the left renal collecting system than of the right. This was interpreted erroneously as decreased left renal excretory capacity. Functional tests of each kidney did not support this interpretation. (Table I.) The glo-

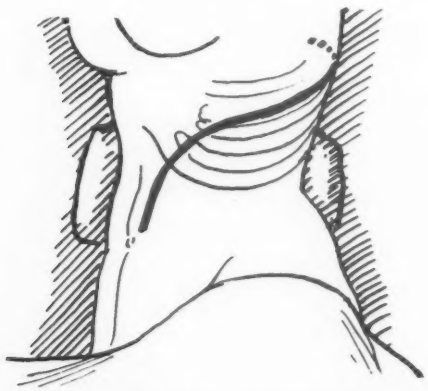


FIG. 4. Case III, incision for aortorenal graft.

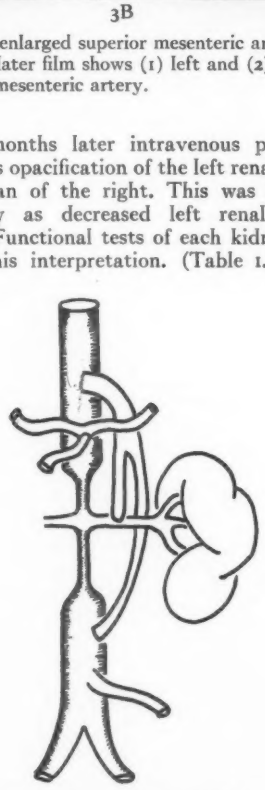


FIG. 5. Case III, diagram of homograft used to bypass the coarctation of the abdominal aorta.

TABLE I
WATER DIURESIS

Data	Normal Kidney (Right)	Postoperative Kidney (Left)
Water (ml. per minute).....	2.8	13.7
Sodium (mEq./L.).....	7.9	31.0
Creatinine (mg./100 ml.).....	4.2	2.5
Osmolality (mOsm/L.).....	1.39	96
U.V. Creatinine (urine creatinine × Volume [ml./minute])	11.7	34.2

merular filtration rate and volume output of the left kidney were consistently two to four times greater than that of the right kidney. For this reason a synthetic graft was placed between the abdominal aorta and the right renal artery in an attempt to improve the blood flow to the right kidney. However, the graft thrombosed soon after operation. Right nephrectomy performed ten days later was followed by a fall of the blood pressure to 140/80 mm. Hg. Subsequent studies of renal function of the left kidney showed a urea clearance of 35 per cent for fifteen minutes. The patient is asymptomatic and has remained normotensive for the eighteen months since right nephrectomy and revascularization of the left kidney.

CASE IV. J. C., a twenty-seven year old woman, entered the hospital because of hypertension resistant to therapy with drugs. She had been in good health except for high blood pressure for a known duration of five years and a transient episode of facial nerve paresis and ankle edema during her last pregnancy three years ago.

The patient's blood pressure was 210/100 mm. Hg and her pulse rate was 88 per minute. Her urine contained 5 to 6 red blood cells and 1 to 2 white blood cells per high power field but no albumin or sugar. The urinary specific gravity was 1.010. The blood urea nitrogen was 9 mg. per cent. The concentrations of serum electrolytes and the urine catechol amines were normal. The phenolsulfonphthalein excretion was 15 per cent in fifteen minutes and 45 per cent in sixty minutes.

Renal function of each kidney was measured during mannitol diuresis. A No. 8 French ureteral catheter with Braasch bulb was inserted into each ureteral orifice. No urine was obtained from the right kidney during one hour, although saline could be injected and aspirated easily via the right ureteral catheter. There was no significant leakage around the ureteral catheters into the bladder. The creatinine clearance from the left kidney was

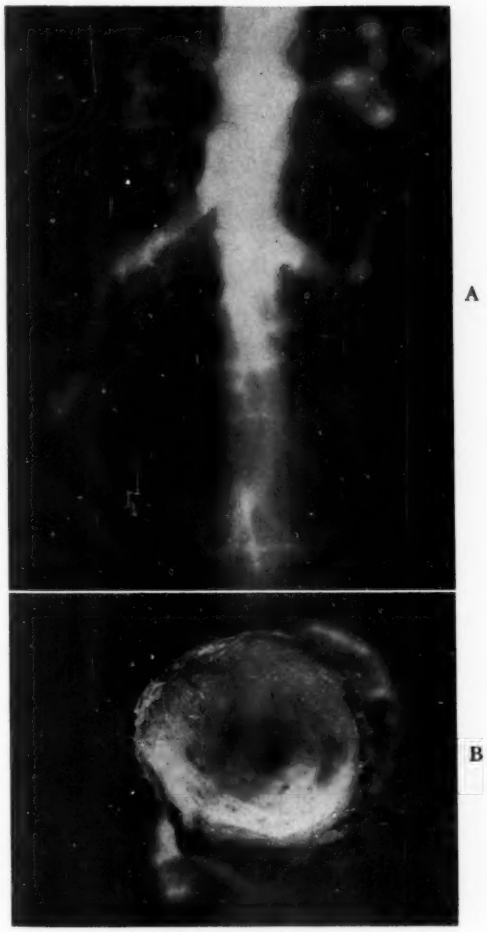


FIG. 6. Case IV, fibrotic stenosis of the renal artery. A, the right renal artery is irregularly constricted (arrow) at the distal portion. B, resected segment of renal artery.

70 ml. per minute. Intravenous pyelography was repeated because of the inability to obtain urine from the right side. It showed normal renal excretory systems, but the size of the right kidney was slightly smaller than the left. Retrograde renal aortography with serial renal arteriograms demonstrated a narrowed, long and tortuous right renal artery. (Fig. 6A.) The left renal artery was normal. The venous nephrogram showed accurately the parenchymal outline of the small right kidney.

Transabdominal exploration of the right renal vessels disclosed a short stenotic segment in a long renal artery. The stenotic portion of the artery (Fig. 6B) was resected and the renal artery recon-

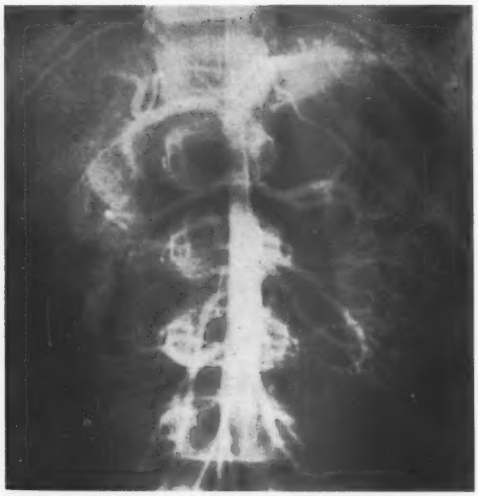


FIG. 7. Case v, hypoplastic kidney. The arterial phase of the right (R) and the left (L) kidney demonstrate normal renal arteries. The outline of the kidney parenchyma is more accurately outlined in the nephrogram than it is in an intravenous pyelogram. Demonstrated in this nephrogram are a small right kidney and an enlarged left kidney.

stituted by end to end anastomosis. Postoperatively, the blood pressure fell to 140/80 mm. Hg and has remained at this level for ten months. Miscroscopic examination of the arterial segment removed showed increased fibrous tissue in the media. The etiology of the peculiar fibrosis in the artery of this patient was similar to that reported by Poustasse [6] and its cause has not been determined.

CASE V. M. H., an eleven year old boy, was brought to the hospital because of headaches which were often accompanied by nausea and vomiting for the past five years. Recently, periods of diplopia had been noted. He had had nocturia and enuresis for six years.

The child appeared chronically ill, was slightly underweight but was of normal height. His blood pressure was 175/120 mm. Hg in the left arm, 170/125 mm. Hg in the right arm, 220/140 mm. Hg in the left leg and 210/45 mm. Hg in the right leg. There were no retinal hemorrhages or exudates. The results of a phentolamine (Regitine) test were normal. The urine contained a normal concentration of catechol amines, a trace of albumin but no granular casts. The excretion of phenolsulfonphthalein was 45 per cent in fifteen minutes and 90 per cent in one hour.

A percutaneous transfemoral renal arteriogram was performed. (Fig. 7.) Transabdominal exploration of the kidneys showed the right one to be 9 cm. long and the left one to be 15 to 16 cm. long. The right kidney was removed. A scar in the upper pole of the kidney extended to the superior calyx. Normal cellular architecture was absent in this area. The pathologic diagnosis was hypoplasia of the right kidney with cortical scar. The scar may have resulted from a renal infarct. After operation, the blood pressure fell stepwise for two weeks to a level of 140/80 mm. Hg and has remained at this level for six months.

CONCLUSIONS

Unilateral kidney disease and renal arterial abnormalities are important causes of arterial hypertension because they often are correctible by surgery. The progressive contralateral renal changes produced by persistent hypertension are avoided, as are the risks associated with long periods of administration of hypotensive drugs. To discover the correctible lesions producing hypertension, the examination of the patient must include the following: (1) tests for coarctation of the aorta; (2) tests for pheochromocytoma and other endocrine abnormalities [7]; (3) renal tests administered in the sequence (A) phenolsulfonphthalein, (B) urine concentrating capacity, (C) blood urea nitrogen, (D) urea or creatinine clearance and (E) intravenous pyelograms, with any abnormality of the pyelogram investigated by separate renal tests [7]; and (4) renal aortography in selected patients.

Tests of renal function of each kidney should be carried out for most patients [8] who have evidence of unilateral renal abnormalities. They serve a twofold purpose: establishment of the functional capacity of both the diseased and normal kidneys. Glucose infusion or water loading [9] provide adequate urine flow, thereby increasing the reliability of the values for creatinine and urea clearance. Determinations of urine sodium concentration and osmolality should be made simultaneously with those of the plasma.

Unilateral obstruction of the renal artery usually is associated with (1) a lower urine sodium concentration, (2) a slower rate of urine flow (ml. per minute) and (3) a lower glomerular filtration rate in the affected kidney than in the contralateral one [10,11]. The urine osmolality (milliosmols per liter) may be equal to or greater than that of the normal kidney. These data are useful, but may be difficult to interpret when bilateral arterial lesions, mixed renal diseases or segmental infarction exists.

The technic of collecting urine from each ureter must also prevent loss of urine into the bladder if correct glomerular filtration rates are to be obtained. Bleeding from a ureter obviously will affect the accuracy of values for urine sodium since the plasma sodium concentration is usually much greater than that of the urine. Introduction of a ureteral catheter may be followed by periods of oliguria in one kidney (Case IV). These technical problems limit the value of tests of unirenal function. Complete reliance upon the urinary sodium concentration in the diagnosis of unilateral renal disease is unwarranted at this time because of the inconsistent correlation with the arteriographic and operative findings. Connor's case reports [9] point out the difficulties inherent to ureteral catheterization tests. The inequalities of the glomerular filtration rate and sodium excretion of the separate kidneys in essential hypertension [*11,12*] *emphasize the importance of arteriographic demonstration* of renal lesions before surgical treatment is proposed. Unless this is done, the results of such therapy will be unsuccessful. The inadequacy of intravenous pyelography and divided renal function tests have resulted in the increased use of renal arteriography in this hospital.

The Use of Percutaneous Renal Arteriography. An accurate determination of the size of the kidney and of the caliber and uniformity of the renal artery is secured by percutaneous transfemoral aortography. This method demonstrates the arterial system of both kidneys simultaneously (Figs. 1, 3 and 4). A subsequent venous nephrogram (Fig. 1B) outlines sharply the parenchyma of both kidneys. Significant obstruction to the flow of blood through the renal arteries is evident by a defect seen in the column of intra-arterial contrast material and by the persistence of the arterial phase of the nephrogram of the normal kidney. (Fig. 1.) Unilateral renal parenchymal disease causing reduced renal mass is accompanied by a small renal shadow in the venous nephrogram. (Fig. 7, Case V.) A venous nephrogram shows the outline of the renal size more accurately than does an intravenous pyelogram.

The indications for detailed examination of renal function in patients with hypertensive cardiovascular disease depend upon the history, symptoms and signs exhibited by each patient. Renal arteriography should supplement tests of renal function if any of the following conditions exist: (1) the hypertension is known to be of recent onset, (2) symptoms referable to one kidney exist, particularly unilateral pain or thromboembolic disease, (3) evidence of unilateral renal disease by pyelography, (4) difference in size of kidney of 1 cm. or more in a roentgenogram, (5) sudden malignant course in a hypertensive patient who has been responsive to medical treatment, (6) sudden hypertension or acute renal failure in a patient after operations around the aorta or renal arteries and (7) hypertension in any patient less than thirty-five years of age.

These are relative guides to the employment of renal arteriography. The use of studies with radioisotopes of individual renal function [*13,14*] may offer more accurate selection of patients for renal angiography which is limited in screening large numbers of patients. The function of both kidneys must be known *before nephrectomy is recommended* or operations are performed on the renal vessels.

Renal arteriography has been of great value in the diagnosis of abnormalities which can be corrected by revascularization of the affected kidney without nephrectomy. This is particularly true for patients with arteriosclerotic renal artery obstruction (Case I) in whom the disease may extend to involve the second kidney at a later date. Removal of one kidney would complicate therapy if extension of the disease to the opposite side occurred. Accurate delineation of the vascular abnormality also provides valuable information for selecting the proper operative technic.

Autograft shunts of the splenic artery to the renal artery (Case I), primary reconstruction (Case IV) and arterial substitutes (Case III) are applicable in cases of specific lesions. Nephrectomy is commonly necessary (Case II) in patients with unilateral parenchymal disease, but segmental resection has been used recently to relieve hypertension in some patients [*8*]. Exact knowledge of the abnormalities and functional capacity of each kidney is essential for planning proper therapy, but surgical treatment depends substantially upon arteriographic demonstration of the lesion.

SUMMARY

Five examples of pathologic conditions of the kidney and renal arteries which can be corrected surgically are presented together

with the significant diagnostic data and a description of the therapeutic technics employed. A diagnostic approach to the problem of renal hypertension is commented on, with emphasis on the value of serial renal arteriography.

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Replacement of the Cervical Segment of the Esophagus with an Aortic Homograft

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RESECTION and reconstruction of the cervical portion of the esophagus as a surgical approach to the treatment of malignant disease of this segment is a procedure which is performed infrequently. This is due in part to the relatively low incidence of involvement of this region by carcinoma and in part to the fact that when such a lesion is detected it is too often not amenable to surgical resection. Thus, in six years' experience at the Memorial Hospital, New York (1940 to 1946), only seventy-seven patients who had carcinoma of the cervical portion of the esophagus were treated surgically; of these, resection was possible in only seven patients [1]. Wookey [2] has been referred to in the literature frequently and his procedure for reconstruction of the cervical esophagus is well known. Actually, his original report in 1942 dealt with only four cases. Therefore, it is apparent that even in the larger centers and in the hands of men especially interested in this field, reconstructive surgery of the cervical segment of the esophagus is not common.

This is also true in the Long Beach Veterans Administration Hospital. Although about 2,500 patients per year are treated surgically in this hospital which has functioned since 1946, reconstruction of the cervical segment was not performed until 1958. Forty-five patients with carcinoma of the esophagus have been admitted to the hospital since 1950. Of these, the lesion was in the cervical segment in four, two lesions were primary and two were secondary. Neither of the first two was considered resectable.

CASE REPORTS

CASE I. A fifty-eight year old white man began to have difficulty in swallowing in August 1953. This was associated with hoarseness. After a period of symptomatic treatment including therapy with penicillin, he was admitted to the Whipple Veterans Administration Hospital in Arizona on November 30, 1953. He gave a history of having had surgical treatment for tuberculosis of the cervical lymph nodes in 1919. The significant findings during general examination were loss of weight and fetid odor of the breath. Results of laboratory examination, including examination of the blood and urine, were negative. Roentgenographic examination of the thorax disclosed evidence of pulmonary emphysema. Laryngoscopic examination showed tumor tissue about the esophageal orifice and paralysis of the left vocal cord. The diagnosis of the tumorous tissue obtained by biopsy was epidermoid carcinoma, primary in the esophagus. Cervical lymph nodes became palpable during the hospitalization. The lesion was considered to be nonresectable. The patient was transferred to the Long Beach Veterans Administration Hospital on January 5, 1954, for consultation and further therapy. The Tumor Board at this hospital also considered the lesion to be nonresectable because of the high location of the esophageal tumor and because of the presence of bilateral enlarged cervical nodes which were thought to contain metastases. Radiation therapy was not recommended. He was discharged on January 19, 1954, and was readmitted to the Whipple Veterans Administration Hospital on February 19, 1954, because of pain, dyspnea and vomiting. He expired on April 23, 1954. The diagnosis made at autopsy was metastatic carcinoma of the cervical segment of the esophagus and bronchopneumonia.

CASE II. A sixty-nine year old male patient was admitted to the Whipple Veterans Administration Hospital on March 29, 1955, because of dysphagia for two months. He had been hospitalized several times previously for paralysis agitans and arteriosclerotic vascular disease. There had been recent loss in weight. Physical examination revealed a generalized coarse tremor, muscular rigidity, atrophy of the interosseous muscles of the hands and muscular wasting of the upper extremities. No nodes were palpable in the neck. The results of

routine laboratory studies and x-ray films of the chest were noncontributory. An esophagram showed an obstructing lesion in the cervical segment. This was seen by esophagoscopy as a fungating mass of pinkish gray tissue at the 15 cm. level from the front teeth. A specimen obtained by biopsy indicated the lesion was epidermoid carcinoma, primary in the esophagus. Because of the location of the lesion and because of the patient's age and general condition, surgery was considered to be contraindicated. He was transferred to the Long Beach Veterans Administration Hospital on May 25, 1955. Radiation therapy was initiated on May 29, 1955, and was terminated after twenty-eight treatments on June 29, 1955. The tumor was subjected to an estimated total of 5,936 roentgens (28,000 air roentgens). The patient was able to eat and was gaining weight when he left the hospital on July 21, 1955. The patient again had difficulty in swallowing a few weeks after discharge; the dysphagia became progressively worse and was accompanied by loss of weight. He expired on November 19, 1955. The chief finding at autopsy was a tumor in the cervical portion of the esophagus with complete obstruction. No areas of metastases were found. There were associated findings of pulmonary edema, pneumonitis and generalized cerebral arteriosclerosis.

COMMENTS

In reviewing these cases, one is struck by the fact that surgical removal was possible in each patient. Surgery was not considered because the usual multiple procedures necessary to reconstruct the cervical portion of the esophagus probably would not have been tolerated by the patients. Most procedures designed to reconstruct the cervical segment of the esophagus require multiple stages. The Wookey procedure [2] requires at least four major operations. Grimes and Stephens [3] reported a procedure for reconstruction of the cervical esophagus which involves a minimum of two operations to be performed at least three months apart. Difficulty was reported in two cases in which concomitant cervical lymphatic dissection was performed. Conley [4] reported a one stage reconstruction using a plastic stent inside of a split-thickness skin graft. Grimes and Stephens attempted this without success in two instances. In each patient it was necessary to remove the stent because of the pain it caused. Both grafts stenosed completely, and gastrostomy was necessary. It was their opinion that stent material causes a foreign body reaction and sets the stage for scarring and stenosis.

A one stage procedure would be preferable for several reasons. It would reduce the operative risk, it would cut down the number of hospital days and it would decrease the expense to the patient. Furthermore, a one stage procedure is especially advantageous if previous surgery has been performed on the neck. In such cases, multiple stage procedures are almost impossible to perform. (When concomitant neck dissection is carried out, the flaps are so extensive that necrosis may occur.) The method used in the following case is suggested as a possible answer to the need for a one stage procedure. This is, to our knowledge, the first report of successful replacement of the cervical esophagus by aortic homograft. We have heard oral reports that this has been accomplished, but we have been unsuccessful in finding any references to it in the literature. Rogers [5] reported one case of reconstruction of the thoracic esophagus by aortic homograft.

Case III. A fifty-five year old male patient had a hemilaryngectomy on July 30, 1952, for treatment of squamous cell carcinoma of the larynx. He was followed at three month intervals with no evidence of recurrence until January 30, 1957. At that time the specimen obtained by biopsy showed a recurrence of the squamous cell carcinoma; a total laryngectomy was performed on February 20, 1957. A transient tracheoesophageal fistula developed, but was closed by March 7, 1957. The patient was again followed at three month intervals. He was readmitted on September 22, 1958, because of hemoptysis. A hard mass was felt in the thyroid area of the neck. An esophagram showed constriction at the hypopharynx. Esophagoscopy showed a tracheoesophageal fistula with a small area of tumor at the site of the fistula. Biopsy proved this to be a squamous cell carcinoma, presumably metastatic from the larynx. On November 28, 1958, resection of the involved trachea, esophagus, thyroid and parathyroid glands was performed. An aortic homograft was sutured into place to replace the esophagus removed. The patient was fed through a nasogastric tube postoperatively. A transient esophageal salivary fistula developed and was closed by conservative therapy.

A barium study revealed apparent complete obstruction at the site of the previous fistula. On January 28, 1959, the patient's pharynx and site of anastomosis were examined using a direct laryngoscope. At the extreme tip of the instrument, a stricture was seen with suture material protruding. There was no gross evidence of neoplastic

tissue. The stricture was gradually dilated with No. 12F to No. 30F filiform bougies* under direct vision. Subsequently, the patient was seen at two day intervals; the stricture was progressively dilated by gradually increasing the size of woven silk bougies (to No. 44F).

An esophagoscopy was then accomplished using a 30 cm. Schindler-type esophagoscope† which was readily introduced and advanced to its full depth. The esophageal mucosa was everywhere normal in appearance. The interposed segment of aorta was narrower in caliber than the esophagus and its walls were more rigid. The lining of the aortic segment was smooth and glistening. Again, suture material was noted proximally where the aorta was anastomosed to the pharynx.

The patient was then trained to pass the No. 44F bougie once daily, which he continued to do thereafter. He subsequently was able to ingest food with only slight dysphagia. On one occasion, a bolus of meat stuck in his esophagus which he could not regurgitate. He used the silk bougie to push it on through and was then able to continue eating.

Following this the patient ate well and gained weight. Replacement therapy with thyroid and dihydrotachysterol was initiated. On March 24, 1959, severe gastrointestinal bleeding occurred and a blood transfusion was given. The bleeding recurred on April 1, 1959; at this time it was diagnosed as resulting from a gastric ulcer. A wedge resection of a large bleeding gastric ulcer was performed together with vagotomy and pyloroplasty. Postoperative roentgenograms showed no obstruction in the cervical esophagus. (Fig. 1.)

FIG. 1. Postoperative esophagram showing some narrowing but no obstruction.

The patient was discharged from the hospital on May 16, 1959. He was killed in an automobile accident on May 18, 1959. Autopsy indicated the cause of death was traumatic rupture of the aorta at its origin due to the crushing injury to the thorax. Examination of the anastomosis showed a satisfactory lumen without significant stricture. There was no evidence of residual tumor in the neck, trachea or distant organs.

CASE IV. This patient, a forty year old man, gave a history of increasing hoarseness and dysphagia for a period of six months before entry into the hospital. A direct laryngoscopy, performed on December 5, 1958, showed a tumor involving the right arytenoid, right piriform sinus and the entire right side of the larynx. Biopsy specimens from the right anterior portion of the cord showed no tumor. Biopsy specimens of the right arytenoid and right piriform sinus showed epidermoid carcinoma, grade 2, primary in the larynx. The results of routine laboratory examinations and the roentgenograms of the chest were normal.

A total laryngectomy and radical dissection of the right side of the neck were performed on December 11, 1958. The cervical segment of the esophagus was found to be involved; this portion was resected. An aortic homograft was used to replace the defect. It was believed that the lumen of the graft was too small; it was cut lengthwise and sutured to another portion of the graft, which was also cut lengthwise, thereby doubling the circumference. Nonviable graft was sutured to nonviable graft to accomplish this. A nasogastric tube was inserted beyond the site of the anastomosis and connected to a suction device. Feedings were initiated through the tube on the eighth postoperative day. On the tenth postoperative day the wound in the skin showed evidence of infection and there was drainage of food material through it. Review of the x-ray films revealed the tip of the tube was in the lower esophagus above the cardioesophageal area. This was corrected and the tube replaced in the stomach. Feeding was discontinued. In spite of debridement, administration of antibiotics and provision of adequate drainage, the

* Manufactured by Dr. S. Jackson, Washington, D. C.
† Manufactured by Cameron Surgical Instruments Co., Chicago, Illinois.

infection in the neck steadily became worse. He died of carotid artery rupture on the twenty-second postoperative day.

SUMMARY

1. A review of our total experience with cancer of the cervical segment of the esophagus, both primary and metastatic, has been presented.

2. A successful replacement of the cervical esophagus with an aortic homograft is recorded. This is the first case of this type of which we are aware.

3. An unsuccessful example of a similar procedure is included. It exemplifies that the graft should be sutured only to living tissue, not to itself.

4. The procedure has the advantage of being performed in one stage.

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Acute Superficial Saphenous Thrombophlebitis

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THE TREATMENT of acute superficial saphenous vein thrombosis in the past consisted of bed rest, elevation of the extremities and elastic supports. In recent years, treatment has included the administration of anticoagulant drugs. Two to four weeks of such therapy often are required before the signs of acute inflammation subside. Even then the process is prone to recur. Some persons actually have long periods of disability because of intermittent or recurrent bouts of acute venous thrombosis in the same area of the superficial venous system despite anticoagulant drug therapy. The excision of such a chronically diseased vein has been known to relieve patients suffering from recurrent segmental phlebitis.

Excision of thrombosed veins was begun three years ago as treatment for a few persons who had repeated disabling attacks of acute

1A 1B 1C

FIG. 1. Acute superficial thrombophlebitis, present three weeks. The extent of the thrombophlebitis is shown in A, the excised vein segment in B and the incision as it appeared at time of discharge four days later in C.

* Present address: Tyler, Texas.

TABLE 1

ACUTE SUPERFICIAL SAPHENOUS THROMBOPHLEBITIS TREATED BY EXCISION

Patient		Duration of Acute Symptoms (days)	Associated Disease States	Postoperative Complications	Duration of Postoperative Hospital Stay (days)
Age (yr.)	Sex				
			A. Recurrent Acute Thrombophlebitis		
52	F	60	None	0	7
50	F	7	None	0	6
43	M	14	None	0	8
67	F	60	None	0	7
64	M	10	None	Wound hematomas*	22
			B. Acute Thrombophlebitis in Varicose Veins		
66	F	14	None	0	3
65	M	7	None	0	3
57	M	21	None	0	4
45	M	12	Pulmonary emboli	0	12
44	F	21	None	0	7
66	F	7	Pneumonia	0	4
57	M	10	None	0	4
73	M	...	None	0	7
46	F	42	Onset two weeks postoperatively†	0	10
65	M	30	None	Thrombosis in residual varicosities	8
41	M	3	None	Nonfatal pulmonary embolus	19
			C. Acute Thrombophlebitis without Varicosities		
59	M	...	None	0	2
65	F	...	None	0	2
54‡	F	...	None	0	3
37	F	2	Postpartum two days	0	6
37	F	4	Pregnant (six months)	0	9
27	F	4	Pregnant (eight months)	0	4
58	F	21	Hernia repaired sixty days before	Died*	14

* Administration of Dicumarol was the postoperative treatment. Postmortem examination showed death to have resulted from cerebral vascular thrombosis.

† An anterior-posterior vaginal repair was performed.

‡ Three months following excision of the vein in the right leg, this patient was readmitted and the vein in the left leg was excised. There was no associated disease nor were there postoperative complications. The patient remained in the hospital for three days following operation.

superficial venous thrombosis in a lower extremity which could not be controlled by anticoagulants. It was hoped that the recurrent disability and the repetitious nature of the thrombosis might be stopped without much risk. Because the procedure proved to be so successful in these first cases of recurrent thrombophlebitis, its use was extended to less complicated cases.

RESULTS AND COMMENTS

Summarized in Table 1 are our experiences with twenty-three patients in whom acutely thrombosed superficial saphenous veins were

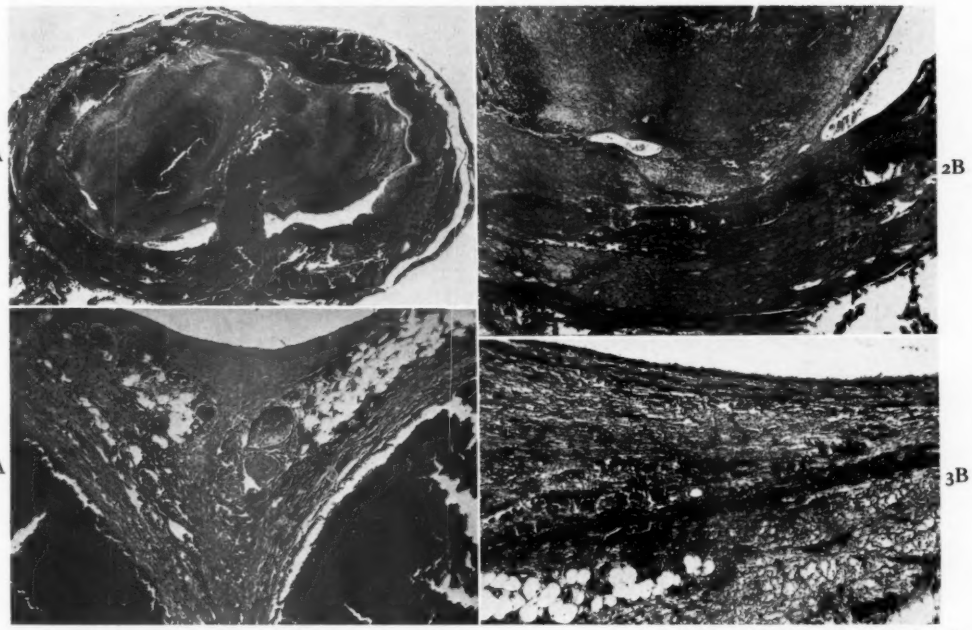

FIG. 2. A, illustrated is a segment of saphenous vein containing an organizing thrombus that partially occludes the lumen. The vein wall is thickened as is the valve in the center of the vessel. The patient had had varicosities for many years without a history of previous thrombophlebitis. (Original magnification × 12.) B, a higher magnification of a portion of the vein and thrombus seen in A. Fibrotic thickening of the intima and media is evident. The thrombus is well organized. (Original magnification × 40.)

FIG. 3. A and B, these photomicrographs show thin-walled veins which contain recent thrombi. The intima, media and adventitia are acutely inflamed. The elastic tissue fibers are partially fragmented and the adventitia is edematous (B). (Original magnification of A, × 80; of B, × 90.)

excised. The period of hospitalization in most cases was a week or less. No serious complications developed which were attributable to the operation. Healing of the wound without infection was the rule. A preoperative and postoperative appearance typical of these patients is shown in Figure 1. In one man, signs and symptoms of a pulmonary embolus developed three days postoperatively, but they subsided and did not recur.

Five of the twenty-three patients in whom the acutely thrombosed saphenous magna vein was excised had previously had recurrent bouts of phlebitis in the involved vein for many months or years. Anticoagulant drugs (usually Dicumarol®) had failed to control the process in all five. In another patient, the thrombosed vein was excised because administration of Dicumarol had not prevented progression of the initial bout of thrombosis.

Eleven patients had had varicose veins for many years but had not had a previous episode of acute superficial thrombophlebitis. The seven remaining patients with superficial thrombophlebitis in the legs did not have a history of antecedent venous disease.

Sections (stained with hematoxylin eosin and Verhoeff-Van Gieson stains) of the excised segments of these recently thrombosed saphenous veins were reexamined. None of the veins examined was entirely normal. For the most part, thrombi in various stages of organization were present. Those showing advanced organization were associated with intimal thickening and hyalinization of the vessel. The media was frequently hyalinized with interruptions or disappearance of the smooth muscle. (Fig. 2.) There were inflammatory cells infiltrating the media and adventitia of all veins containing thrombi. (Fig. 3.) Increased vascularity of the media and adventitia accompanied the inflammation. Medial calcification was seen in one large vein, and in another specimen calcification was noted in

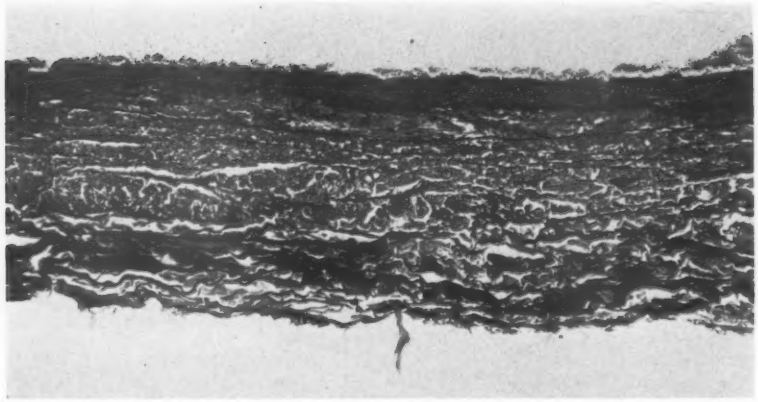

FIG. 4. Photomicrograph of a segment of normal saphenous vein. (Original magnification × 130.)

the media of tributaries to the saphenous vein. A section of apparently normal vein is shown for comparison. (Fig. 4.)

The treatment of recurrent thrombophlebitis by excision of the diseased veins has been practiced with success for many years. Such treatment for acute thrombosis occurring for the first time in either varicose or nonvaricose veins, though not so often recommended, likewise appears to be beneficial.*,† The periods of disability associated with the acute phlebitis have been shortened in most instances.

CONCLUSIONS

Theoretic objection to operative therapy for acute superficial thrombophlebitis has resulted from the fear of pulmonary emboli or deep venous thrombosis incident to the operative manipulation.

The rapid relief of symptoms, the paucity of complications from the wound and the absence of serious complications associated with the excisional therapy of twenty-three patients suggest that these objections have little basis in fact.

The satisfactory results obtained by removal of acutely thrombosed superficial veins in the lower extremities justify the use of excision of the thrombosed veins as the treatment of progressive acute superficial thrombophlebitis (when uncomplicated by signs of extensive deep venous thrombosis) which cannot be controlled by anticoagulants. This may be the best way of treating extensive acute thrombosis limited to the saphenous systems without recourse to a preoperative trial of the effectiveness of anticoagulants and other measures.

* HERMANN, L. G. Phlebectomy in treatment of acute thrombosis of saphenous varices (a case report). *Arch. Surg.*, 64: 681, 1952.

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Surgery for Gallbladder Disease in Ohio

A SURVEY OF 3,085 OPERATIONS

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From the Survey Committee, Ohio Chapter of The American College of Surgeons. Presented at the Fifth Annual Meeting of the Ohio Chapter, American College of Surgeons, Akron, Ohio, September 9, 1960.

THIS study of 3,085 operations on the biliary tract for non-neoplastic disease was carried out in thirty Ohio hospitals in eighteen communities in 1959. The study is based on thirty-one series of cases collected by members of The American College of Surgeons throughout the state. Twenty-five of these represented successive cases from the hospital in which the member surgeon operated. Six series were successive operations performed by the member making the report. Nearly all the operations were performed in 1959. Special attention was paid to the subjects of surgery, the type of operation, hospital mortality, frequency of cholangiograms, indications for opening the common duct and the performing surgeons.

SEX AND RACE

Of the 3,085 operations reviewed in this study, 74 per cent were performed upon white women and 22 per cent upon white men, a ratio of slightly over three women to one man.

MORTALITY AS RELATED TO AGE

Table I shows mortality as related to the age of the patient, the over-all mortality being 1.2 per cent. The peak number of patients in any decade occurred in the fifties. No deaths occurred under the age of forty, only one under the age of fifty and only three under the age of sixty, which included 69 per cent of the entire series. The progressive rise in mortality with increasing age reached 16 per cent for those eighty years of age and over.

ACCURACY OF PREOPERATIVE RADIOGRAPHS

Among 1,925 patients in whom preoperative x-ray films were interpreted as showing gallstones either by plain x-ray films or cholecystograms, stones were found at operation in 97 per cent. Among 917 patients that showed no function of the gallbladder by cholecystogram, stones were found at operation in 91 per cent.

COMMON DUCT EXPLORATION

Common duct exploration was carried out in 594 of the 3,085 operations (19 per cent). Common duct stones were found in 287 of these (9 per cent of the whole or 48 per cent of the common duct explorations).

Table II shows the frequency of common duct stones when the duct was opened for various indications. There was more than one indication for many patients for opening the common duct, hence the total in column two is greater than the number of common duct

TABLE I
AGE DISTRIBUTION AND MORTALITY

Age	No. of Patients	No. of Deaths	Mortality Per cent
Under 20 yr	28	0	0.0
20–29	276	0	0.0
30–39	489	0	0.0
40–49	585	1	0.17
50–59	764	2	0.26
60–69	651	13	1.9
70–79	256	16	6.2
80 and over	36	6	16.6
Total	3,085	38	1.2

*Chairman, Survey Committee.

TABLE II
FREQUENCY OF COMMON DUCT STONES WITH VARIOUS INDICATIONS FOR OPENING DUCT

Indications	No. of Cases Explored	No. of Stones Found	Per cent
Jaundice	264	162	61
Dilated ducts	301	158	52
Small stones	206	113	55
Positive cholangiogram	124	84	68
Palpable stones	13	13	...

explorations. However, the attempt in this study was to determine the value of each indication separately.

Here 264 patients either had a history of jaundice, were clinically jaundiced or had laboratory evidence of jaundice at the time of their operation. Of this group 61 per cent were found to have stones in the common duct when the duct was opened. Among the patients explored who had dilated cystic or common ducts, 52 per cent were found to have stones as seen in Table II. The percentages of patients with stones is also given for other indications.

Through an oversight, palpable stone in the common duct was not asked for in the original analysis cards. In thirteen instances it was written in as an accurate indication of stone in the duct. With the exception of this small group of cases, it is seen that cholangiography was the most accurate indication (68 per cent) and that jaundice of any type was the next most accurate indication of stone in the common duct (61 per cent). In contrast, in 330 common duct explorations without jaundice of any type, the incidence of common duct stone was only 38 per cent. This lends weight to the time-honored indication for common duct exploration: jaundice or a history of it.

MORTALITY RATE FROM COMMON DUCT EXPLORATION

Table III shows the over-all mortality rate among those requiring common duct exploration to be 3.5 per cent as opposed to 0.68 per cent for those having only cholecystectomy. When common duct exploration was carried out as an emergency, the mortality rate was approximately six times greater than when it was an elective procedure.

In regard to the mortality connected with

TABLE III
MORTALITY RATE WITH AND WITHOUT COMMON DUCT EXPLORATION

Procedure	No. of Cases	No. of Deaths	Mortality Per cent
Emergency common duct exploration	37	6	16.0
Elective common duct exploration	557	15	2.7
Total	594	21	3.5
No common duct exploration	2,491	17	0.68

common duct exploration with and without common duct stones, in 287 cases with common duct stones there were twelve deaths or a mortality of 4 per cent. In 307 cases of common duct exploration in which stone was not found there were nine deaths or a mortality of approximately 3 per cent. This indicates that common duct exploration in itself carries a definite mortality.

MORTALITY FROM EMERGENCY VERSUS ELECTIVE OPERATIONS

In this study emergency operation was taken to mean an added case not previously printed or posted on the daily operating schedule. If an acutely ill patient was held over after admission and the operation scheduled for the next day, it was included with the elective operation in this study.

Table IV shows the over-all mortality from emergency operation to be 9 per cent as opposed to the over-all mortality from elective operations of 0.78 per cent in Table V. By similar comparison in these two tables, the mortality from emergency cholecystectomy is seen to be sixteen times greater than that from elective cholecystectomy which is only .25 per cent. The mortality of common duct explorations, without duodenostomy, is seven times greater when performed as an emergency. Opening the duodenum increased the mortality from both the elective and emergency operations, but especially so in the latter group, which undoubtedly included the sicker patients. These figures differ slightly from those in Table III which does not distinguish the common duct explorations with opening of the duodenum.

TABLE IV
EMERGENCY OPERATIONS

	No. of Cases	No. of Deaths	Mortality Per cent
Cholecystectomy	93	4	4.0
With common duct exploration	28	4	14.0
With common duct exploration and duodenostomy	6	2	33.0
With common duct exploration duodenostomy and sphincterotomy	3	0	0.0
Cholecystostomy	28	5	18.0
Total	158	15	9.0

TABLE V
ELECTIVE OPERATIONS

	No. of Cases	No. of Deaths	Mortality Per cent
Cholecystectomy	2,328	6	0.25
With common duct exploration	518	11	2.10
With common duct exploration and duodenostomy	24	2	8.30
With common duct exploration duodenostomy and sphincterotomy	15	2	13.30
Cholecystostomy	42	2	4.70
Total	2,927	23	0.78

Cholecystostomy was performed seventy times in the entire group, with an incidence of approximately 2 per cent. In all other instances, the gallbladder was removed. It is apparent from Table IV and V that the acutely ill patient requiring emergency surgery on the biliary tract is subjected to a much greater risk than if this surgery were performed as an elective procedure before the emergency arose.

THE FREQUENCY OF CHOLANGIOGRAPHY

Operative cholangiograms were made prior to opening of the common duct in 24 per cent of the entire group. In 51 per cent of the common duct explorations operative cholangiograms were made after the duct had been opened. In 75 per cent of the common duct explorations there were postoperative cholangiograms prior to the removal of the T-tube from the common duct. It is assumed that for the remaining 25 per cent there were good negative results in the operative cholangiograms. Postoperative cholangiograms were employed in all thirty-one series of cases and operative cholangiograms in all but three of the series, showing a very wide adoption of this very useful diagnostic tool.

MORTALITY AS RELATED TO PATHOLOGICAL FINDINGS

Table VI shows the mortality as related to pathological findings. For most patients there was more than one pathological finding so that the total in the first column is greater than the total number of patients. It is seen, however, that the mortality is elevated with acute inflammation of the gallbladder and common duct calculi, the mortality from common duct calculi being four times that of gallbladder calculi. Peritonitis from perforation of the gallbladder results in the highest mortality, especially when the peritonitis is generalized in nature. It is of interest that most of the perforations of the gallbladder led to localized peritonitis and that in only eight instances was it described as generalized.

CORRELATION OF MORTALITY RATE AND SURGICAL QUALIFICATIONS

Table VII summarizes the results of the various groups of surgeons. Surgeons who were Fellows of The American College of Surgeons and/or Diplomates of the American Board of Surgery and the residents performed 89 per cent of the operations in this group of hospi-

TABLE VI
MORTALITY AS RELATED TO PATHOLOGICAL FINDINGS

Findings	No. of Cases	No. of Deaths	Mortality Per cent
Gallbladder calculi	2,880	29	1.0
Common duct calculi	287	12	4.1
Perforation of gallbladder with localized peritonitis	35	5	14.2
Perforation of gallbladder with generalized peritonitis	8	3	37.5
Acute cholecystitis	485	17	3.5
Chronic cholecystitis	2,706	19	0.7
Cholesterosis	165	2	1.2

TABLE VII
CORRELATION OF MORTALITY RATE AND SURGICAL QUALIFICATIONS

Qualifications of Surgeon	No. of Patients	Per cent of Whole	No. of Deaths	Mortality Per cent
Diplomate American Board of Surgery only	150	5.0	3	2.0
F.A.C.S. only	276	9.0	7	2.5
Both Board Certified and F.A.C.S.	2,021	65.0	19	0.9
Residents in training	292	10.0	4	1.3
Neither Board Certified nor F.A.C.S.	346	11.0	5	1.4
Total	3,085	...	38	1.2

tals. The lowest mortality rate was in the large group of patients operated upon by surgeons who were both Board Certified and Fellows of The American College of Surgeons. It is interesting that the mortality resulting from the work of these surgeons was less than 1 per cent.

ANALYSIS OF DEATHS

Seventeen of the thirty-eight deaths occurred among men, producing a mortality of 2.4 per cent among men and .88 per cent among women. Thirty-seven of those who died were white and the other individual a Negro. The average age of those who died was seventy-one years, the range being from forty-nine to eighty-five years. Bronchopneumonia and peritonitis each accounted for six deaths, coronary thrombosis five, postoperative hemorrhage four; the balance were due to uremia, pulmonary embolus, persistent common duct obstruction, hepatitis and severed right hepatic duct. An autopsy was performed on twenty of the thirty-eight who died. Fifteen of the deaths (39 per cent) occurred in the 5 per cent of the patients who had emergency operations.

SUMMARY

1. A survey of 3,085 operations performed for nonneoplastic gallbladder disease in thirty hospitals in eighteen communities in Ohio during 1959 is reported.

2. Of the patients 74 per cent were white women.

3. Preoperative x-ray films had an accuracy of 95 per cent in predicting stones in the gallbladder.

4. Common duct exploration in patients with jaundice of any type yielded stone in 61 per cent, without jaundice in 38 per cent.

5. Operative cholangiography was used prior to opening of the common duct in 24 per cent of the patients and was the most accurate indication of stones in the common duct, aside from a small group in which common duct stones were palpated.

6. Mortality showed a progressive climb in the older age groups, reaching 16 per cent in those patients eighty years old and over. There were no deaths below the age of forty.

7. The over-all mortality was .78 per cent for elective and 9.0 per cent from emergency operations.

8. The mortality from cholecystectomy was sixteen times greater when performed as an emergency.

9. Mortality from common duct exploration was approximately six to seven times greater when performed as an emergency.

10. The lowest mortality (0.9 per cent) occurred in the group operated upon by Fellows of The American College of Surgeons, who were Board Certified. The over-all mortality in the entire group was 1.2 per cent.

Acknowledgment: We are grateful to the following members of the Ohio Chapter of the American College of Surgeons for kindly supplying the data from their hospitals: R. M. Bartlett, M.D.; M. A. Orozco, M.D.; F. A. Marquinez, M.D.; C. W. Loughry, M.D.; M. A. Gallagher, M.D.; K. C. Noble, M.D.; R. Concepcion, M.D.; M. B. Taliak, M.D.; R. H. Lechner, M.D.; N. M. Sekerak, M.D.; W. M. Dowlin, M.D.; J. R. Mack, M.D.; F. Amengero, M.D.; S. O. Hoerr, M.D.; C. N. Hinman, M.D.; K. Lim, M.D.; G. H. A. Clowes, Jr., M.D.; J. L. Bilton, M.D.; A. M. Sevilla, M.D.; J. H. Lazzari, M.D.; T. T. Cruz, M.D.; H. M. Gans, M.D.; S. O. Freedlander, M.D.; C. R. Lulenski, M.D.; P. J. Robechek, M.D.; H. A. Fadhli, M.D.; H. K. Wright, M.D.; E. C. Weckesser, M.D.; W. B. Morrison, M.D.; G. D. Kirk, M.D.; R. M. Zollinger, M.D.; R. D. Williams, M.D.; P. Dettman, M.D.; F. L. Shively, Jr., M.D.; C. G. Lovingood, M.D.; A. M. Storrs, M.D.; R. C. Waltz, M.D.; C. E. Holzer, Jr., M.D.; W. F. Hume, M.D.; A. Henrigues, M.D.; C. C. Voorhis, M.D.; C. S. Cortez, M.D.; N. W. Thiessen, M.D.; P. W. Smith, M.D.; J. L. Binkhorst, M.D.; J. R. Wells, M.D.; C. W. McNamara, M.D.; G. N. Bates, M.D.; B. G. Shaffer, M.D.; C. W. McNamara, M.D.; T. J. Hancock, M.D.; B. W Shaw, M.D.; F. A. Cebul, M.D.

Intrauterine Torsion of the Spermatic Cord

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TORSION of the spermatic cord (often erroneously called torsion of the testicle) in children and young adults is encountered with sufficient frequency that most physicians are well acquainted with the rather classic clinical picture. That this phenomenon occasionally occurs in the newborn is not as widely known. Discussions of the entity in current textbooks generally omit this information, and only fairly recently have medical articles shed light on the subject. Gradually the realization has grown that in some instances the torsion has occurred actually *before* birth, apparently during the final days of intrauterine development or possibly during the process of birth. Early torsions of this type present certain characteristics distinct from those occurring in children.

Four cases of this condition have been observed at the Children's Hospital of the East Bay during a fifteen year period, from 1946 to 1961. During this time approximately forty cases of torsion of the spermatic cord have been encountered in children of all ages, so that the newborn represent 10 per cent of the cases. In all four infants the condition was noted within two or three days of birth, and no infant exhibited any systemic evidence of the torsion.

In three cases the gangrenous testicle was removed, and all exhibited severe degeneration of seminiferous tubules, interstitial cells and epididymis. In one case a detorsion of the spermatic cord was effected, and the testicle was sutured to the inner surfaces of the scrotum.

CASE REPORT

D. B., a 9 pound 3 ounce white male infant, was born spontaneously at term after an untroubled gestation. The obstetrician's attention was called almost immediately to the presence of an unusual mass in the right side of the scrotum. The infant was observed by a pediatrician for twenty-four hours during which feedings were readily accepted and there was no indication of pain. He voided normally, temperature was not elevated, and the leukocytic count and urinalysis were within normal limits.

Examination revealed an enlarged, firm, purple, nontender mass which distended the right side of the scrotum, and did not transilluminate. Fixation of the scrotal skin to the underlying mass was noted. The left side of the scrotum contained a testicle and a small hydrocele which did transilluminate.

Thirty hours after birth the infant was operated upon. Exploration of the right scrotum through an inguinal incision revealed a 360 degree counterclockwise torsion of the spermatic cord, proximal to the reflection of the tunica vaginalis at the superior pole of the testicle. (Fig. 1.) Both the scrotal sac and the tunica contained a considerable amount of old blood. There was complete necrosis and degeneration of both testicle and epididymis. This obviously represented a process which had developed over several days.

The necrotic tissues were removed. A small rubber tube was brought out through a stab incision at the lowermost pole of the scrotum to drain the remainder of the extravasated blood. The infant returned home on the first postoperative day.

The removed specimen demonstrated testicular infarction. The tunica vaginalis contained much blood within which appeared ghosts of seminiferous tubules and epididymis. Some of the blood contained granulation tissue and infiltrates of polymorphonuclear cells.

COMMENTS

This patient is representative of those exhibiting intrauterine torsion of the spermatic cord. This condition was first described by Taylor in 1897 [8]. Campbell again called attention to it by reporting two more cases fifty-one years later [3]. He made the important observation that intrauterine torsions of the

FIG. 1. Typical appearance of gangrenous testicle which was removed. Note extravaginal site of torsion of the spermatic cord.

spermatic cord characteristically occur *outside* the tunica vaginalis. In older persons the twist is more commonly within the tunica vaginalis. This is well illustrated in Figure 1.

In 1951 Biorn and Davis [1] reported two more cases encountered in their clinic within a single nine month period. They were the first to observe clearly that in at least one of their cases the torsion must have occurred well before birth, a fact apparent both from the dense adhesions and the degree of testicular necrosis.

James [6] and Franzblau [5] reported two more cases, respectively, in 1953 and 1956. It is quite apparent from the pathologic report of one of Franzblau's cases that the torsion had occurred during intrauterine life, and that degeneration already existed at the time of birth.

The largest series has been presented by Longino and Martin [7] who collected nine cases within a fifteen year period in their hospital. These authors concluded that removal of the infarcted testicle is not necessary in the newborn, and routine exploration of the contralateral testicle was not undertaken. Nevertheless, review of their case reports gives the impression that little recovery of testicular function can be expected.

An interesting review of this condition was made by Bret and Coupé [2] who added three new cases to the literature. Among twenty-one cases analyzed, these authors found that a scrotal mass had been present at birth in twelve and was discovered within the first twenty-four hours in five others.

ETIOLOGY

In light of present knowledge, there is little to offer in explaining the cause of this unfortunate phenomenon. By the third month of fetal life the testicle has developed to the stage that it lies in the iliac fossa close to the groin. Anterior to its lower pole, the peritoneum herniates as a diverticulum, the processus vaginalis, along the ventral aspect of the gubernaculum which is the fibromuscular band which attaches the lower pole of the testicle to the subcutaneous tissue within the scrotum. (Fig. 2.)

It is difficult to picture how a complete rotation of the testis could occur if it were normally suspended, so to speak, by the cord structures above and the gubernaculum below. One suspects that some deficiency in development of the gubernaculum must occur to allow these intrauterine, extravaginal torsions of the spermatic cord.

Whatever the cause, review of those cases in which torsion had occurred prior to birth leads to the conclusion that few, if any, of these testicles are salvageable. When pathologic reports have been available after orchiectomy, they have almost uniformly described severe degeneration and necrosis of the testicle and epididymis. It is highly likely that by the time the infant undergoes surgery, the torsion has been present many hours if not days. In all likelihood it occurs during the final stage of descent of the testis into the scrotal sac. Cooper [4] reports that the tissue of the testicle, especially the interstitial cell, is particularly susceptible to anoxia.

Despite this, two authors have recommended returning the necrotic testicle to the scrotum. We are not in accord with this procedure for

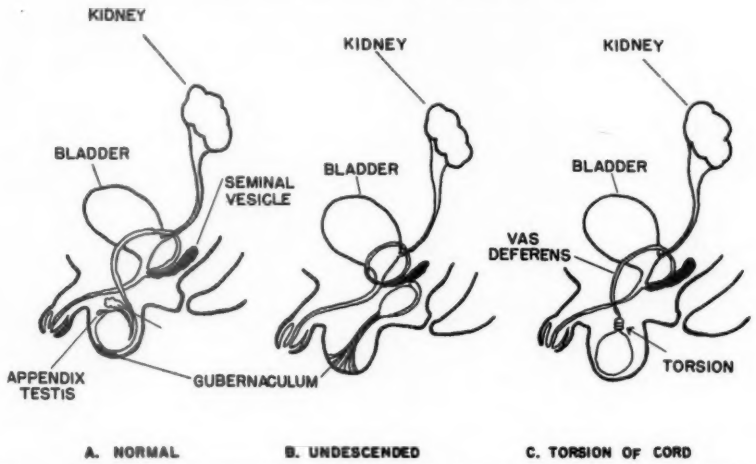

FIG. 2. Schematic representation of embryologic descent of the testicle and classic "intrauterine" torsion of spermatic cord.

the following reasons. These cases always pose a problem in differential diagnosis at the outset. The condition must be differentiated from acute hemorrhagic orchitis, torsions of the appendiceal testis, epididymitis and, most importantly, neoplasia. Therefore, we believe that early surgical exploration is indicated. If torsion is found, it is a violation of sound surgical principles to return this necrotic, decomposing tissue to the body. Torsion is accompanied by considerable extravasation of blood both into the tunica vaginalis and about the tunica within the scrotal sac. Surgical drainage of this blood, together with removal of the necrotic tissue, is indicated here as it is anywhere else in the body where similar disease exists. This is a form of a debridement which rapidly removes a rich potential culture medium for subsequent bacterial invasion.

Another point of contention among various authors has been the matter of exploring the other testicle. This we heartily condemn as unnecessary. When faced with this problem, we are subjecting a newborn infant, recently exposed to the vigorous trauma of the birth process, to the added insult of surgery under general anesthesia. We believe that we have acted in the best interest of the patient when we limit the exploration as expeditiously as possible.

SUMMARY

1. The entity of intrauterine torsion of the spermatic cord is discussed.

2. Characteristically, attention is called to this condition at or shortly after birth by the presence of a hard, nontender, rather fixed mass in one side of the scrotum, and discoloration and fixation of the overlying scrotal skin.

3. At this point the differential diagnosis is between hemorrhagic orchitis, epididymitis, torsion of the spermatic cord and neoplasm of the testicle.

4. Prompt surgical exploration of the involved side is indicated.

5. If intrauterine torsion of the spermatic cord is found, unilateral orchiectomy with scrotal drainage is the treatment of choice.

6. Twenty-five cases of this phenomenon have been described in the available medical literature and are herein reviewed.

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The Use of an Internal Polyethylene Shunt During the Resection of a Carotid Aneurysm

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THE outstanding hazard in the surgery of carotid arteries is that of endangering the cerebral circulation during the period of arterial occlusion necessary for the resection or repair of the diseased vessels. Therefore, a method allowing adequate cerebral circulation during unhurried carotid arterial graft replacement is obviously to be desired.

A case of post-traumatic aneurysm of the common carotid artery is presented in which the aneurysm was resected and a Dacron® graft introduced, while the cerebral circulation was continued through an internal polyethylene shunt.

FIG. 1. Carotid arteriogram showing site of aneurysm.

CASE REPORT

The patient was a thirty-five year old white filling station operator who entered the Denver Veterans Administration Hospital for the first time on October 12, 1959. He complained of a swelling on the right side of his neck which had been present for eighteen years but which had gradually enlarged during the previous year. In 1941 he had been shot in the right side of the neck by a .22 caliber rifle. The bullet entered the neck anteriorly 3 cm. above the right clavicle. The wound of exit was in the right occipital region. At the time of the accident partial paralysis of the right arm and a hematoma in the right side of the neck were observed. The weakness of the arm disappeared completely in a few days, but a slightly tender swelling persisted in the right side of the neck; he noticed that pressure on it tended to make him cough. He had no other symptoms.

On physical examination the patient was a well developed young man in good general health. On the right side of his neck just below the level of the carotid bifurcation, there was a pulsatile swelling, measuring 3 by 4 by 4 cm. It was firm, but not hard, and was relatively fixed. On auscultation a systolic bruit could be heard over the mass. Blood pressure was 110/60 mm. Hg. His heart was normal in size and there was not any evidence of congestive failure or other cardiovascular disease. Other

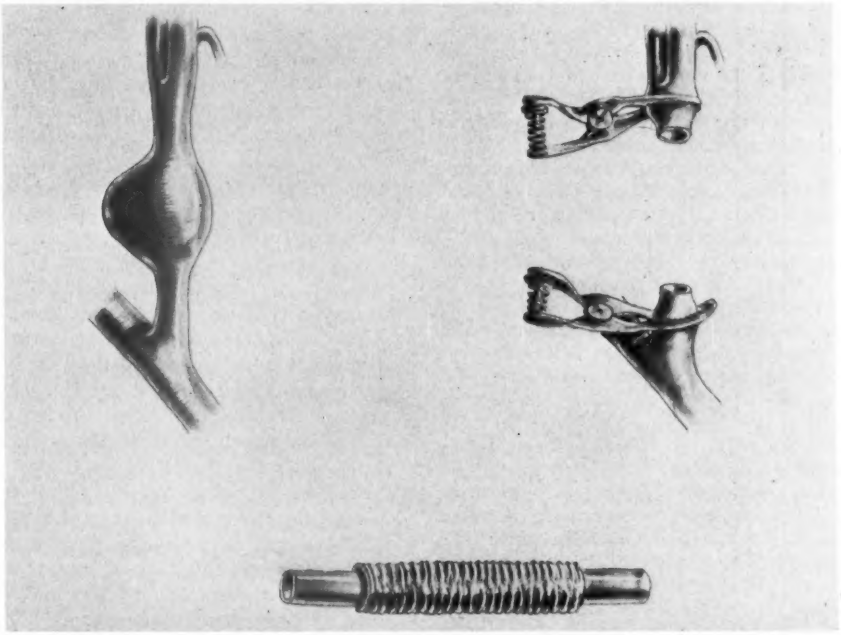

FIG. 2. This shows the appearance of the aneurysm, extent of resection and type of internal polyethylene shunt placed within woven synthetic graft.

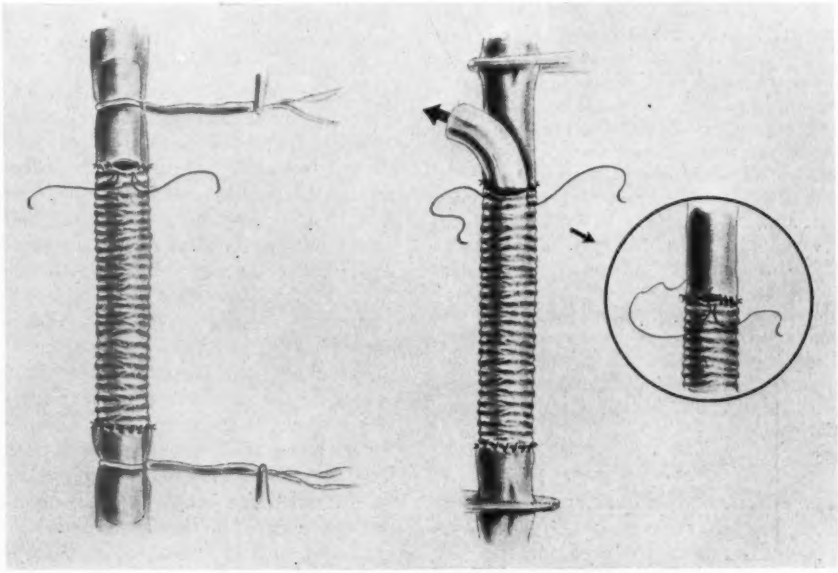

FIG. 3. Completion of anastomosis and removal of shunt.

investigations were as follows: serology, negative; hematocrit, 48 per cent; white blood cell count, 9,400 per cu. mm. roentgenogram of his chest was within normal limits; and in a plain film of the neck, laminated calcification could be seen in the area of the mass. A carotid arteriogram showed an aneurysm of the common carotid artery. (Fig. 1.) Electrocardiogram and electroencephalogram were within normal limits. Preoperative digital occlusion of the right carotid artery for three minutes did not produce any untoward symptoms.

At operation, an incision was made along the anterior border of the right sternomastoid muscle, from the mastoid process to the sternoclavicular joint. The aneurysm was observed to be lying about half-way between the subclavian artery and the carotid bifurcation. The normal carotid artery was cleared of adhesions for several centimeters on each side of the aneurysm and encircled with umbilical tapes. A Dacron knitted graft measuring 5 cm. in length and 0.75 cm. in diameter was slipped over a siliconized polyethylene tube measuring 7 cm. in length and 1 cm. in its outside diameter. With occluding vascular clamps well clear of each end, the carotid artery was transected at each end of the aneurysm, and the open ends of the firm polyethylene tube slipped into the mouth of the vessel. (Fig. 2.) The encircling umbilical tapes were tied snugly over the shunt about 1 cm. back from the open end of the vessel, and the blood flow was restored to the brain by releasing the occluding clamps. The carotid flow was stopped less than three minutes. In retrospect it would have been even simpler to slip the shunt into the carotid artery through a short slit in the aneurysm rather than completely to sever the artery on each end. With blood flowing through the internal shunt, the aneurysm was completely resected and the graft leisurely sewn in place in the usual manner. When all but the last two stitches on the presenting side of the last anastomosis had been placed, the occluding vascular clamps were reapplied and the polyethylene shunt pulled out from the almost completed anastomosis. (Fig. 3.) The small gap through which the shunt had been removed was closed with two additional sutures and blood flow restored through the Dacron graft.

Postoperatively no neurologic defects were observed and the patient's progress was uncomplicated.

Histologic examination of the excised aneurysm showed gross atheromatous infiltration of the intima, with thinning and fibrosis of the media and adventitia.

COMMENTS

Aneurysm of the carotid artery is not common and, of the two main causes, syphilis and trauma, syphilis used to predominate. In World War II there were only five patients with carotid aneurysms of 883 patients with arterial injuries treated in three vascular surgical centers in the United States [1]. In Korea, of 111 consecutive arterial injuries there were six affecting the carotid artery, but there was not a single case of common carotid aneurysm in this series [2].

In World War I the accepted treatment for carotid aneurysms was proximal ligation; but since the Korean conflict, resection and graft replacement has become an accepted approach both for carotid aneurysms and in the treatment of occlusive disease in this region.

Even temporary occlusion of a carotid artery may result in cerebral damage if the vertebral and contralateral carotid arteries are inadequate or if the collateral flow through the circle of Willis is poor. The incidence of such injury varies with the length of occlusion and the underlying pathologic lesion, [3,4], and may be delayed for hours or even several days.

The danger of neurologic damage is less in temporary occlusion than in permanent ligation of the carotid artery, but the threat is great whether surgery is performed for occlusive disease or for aneurysm.

Although of some benefit in predicting tolerance to occlusion, preoperative carotid compression as advised by Matas [5] is unreliable even when maintained for thirty minutes [6]. Trial carotid occlusion with the patient under local anaesthesia with an electroencephalographic monitor [7] may be of some help, but even this can be deceptive.

Faced with the threat of neurologic damage and the virtual impossibility of its prediction, two methods have evolved for its avoidance during carotid occlusion, hypothermia or shunts. Hypothermia has been used extensively but is not completely protective. The use of shunts during critical vascular anastomosis is an old idea. In 1894 Abbe [9] used an intraluminal paraffin-coated glass tube as an aid to end to end arterial anastomosis. This prosthesis was designed to stay in the artery after the anastomosis was complete. De Gaetano [10] subsequently devised a similar tube to be removed as the anastomosis was being finished. Since then a wide variety of both external and internal shunts have been employed.

Internal shunts similar to the one used in the patient reported on herein have previously been used by Lam and Aram [11] in aortic resections and by Crawford et al. [12] in reconstruction

of the carotid artery for obliterative disease. Boatman and Bradford [*13*] used a combination of hypothermia and an internal shunt for the repair by suture of a traumatic carotid aneurysm in a pregnant woman. There has not been a previous report of its use in the carotid artery in combination with an arterial graft.

In reconstructive surgery of the carotid arteries a shunt is advisable whenever possible to obviate cerebral ischemic damage and to facilitate an unhurried repair. An internal shunt is preferable to an external shunt which clutters up the small operative field, encroaches on the short available distal internal carotid artery, and which requires multiple arterial anastomoses. A distinct limitation to the use of an internal shunt in the neck is the necessity of having an adequate sleeve of normal artery on each side of the lesion undergoing repair. Thus an internal shunt is ideally suited for lesions in the middle and lower carotid artery as was demonstrated in the present case. At and above the bifurcation the position of the internal shunt is more difficult to maintain.

We conclude that the surgeon anticipating resection or repair of the lower three quarters of the carotid artery and its bifurcation should be prepared to insert a temporary internal shunt within the encircling graft. Siliconized plastic tubes of varying diameters should be available which can be inserted with a total occluding time of less than three minutes.

SUMMARY

1. The main difficulty in resectional and reconstructive surgery of the carotid artery is the maintenance of an adequate cerebral blood supply during the necessary period of occlusion.

2. The advantages and technic of employing a simple temporary intraluminal shunt made of polyethylene tubing inside of a prosthetic graft have been described.

3. A case of traumatic aneurysm of the common carotid artery has been described in which the aneurysm was resected and replaced by a Dacron graft while circulation was maintained by a temporary internal shunt.

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Experimental Study of Polyester Fiber Suture

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THE characteristics of the various materials used for surgical sutures are well known and each has its advantages and disadvantages [1–3]. The ideal surgical suture has not been found, however, and for this reason, new materials continue to be examined. In recent years, the synthetic sutures, such as Nylon,® Dacron® and Teflon,® have been of interest because of several advantageous characteristics, the most outstanding being the minor degree of tissue reaction to the suture and the maintenance of tensile strength [4,5]. A disadvantage, however, has been the tendency of the knot to slip when tied and to untie in the tissues.

Mersilene® is a polyester fiber obtainable as a braided suture. Studies by others have suggested its acceptability as a surgical suture [6]. Mersilene is chemically the same as the Dacron which we studied previously [9]. The knot made with this material does not slip easily, however, and for this reason, it was compared experimentally with silk and catgut by a technic previously described [7].

TABLE I
TENSILE STRENGTH IN THE WOUND

Suture	Post-operative Days	No. of Animals	No. of Tests	Wound Mean (gm.)	Standard Deviation
Regular silk	2	6	18	1,701	305
	4	6	18	1,413	186
	7	6	18	2,932	470
	14	6	18	2,880	606
	28	5	15	3,566	605
	42	10	29	3,903	610
Polyester fiber	2	6	18	1,942	336
	4	6	18	2,137	590
	7	6	18	2,509	571
	14	6	19	2,804	427
	28	6	18	3,804	708
	42	6	18	3,618	350
Chromic catgut	2	6	18	1,674	343
	4	6	18	1,867	296
	7	6	18	2,070	540
	14	6	18	2,665	561
	28	6	18	3,665	621
	42	7	21	3,012	759

TABLE II
TENSILE STRENGTH OF IMPLANTED SUTURE

Suture	Post-operative Day	No. of Animals	No. of Tests	Mean (gm.)	Standard Deviation	Percent Control
Regular silk	Control	...	25	1,664	68	...
	2	6	18	1,329	342	79.9
	4	6	18	1,382	174	83.1
	7	6	18	1,549	195	93.1
	14	6	18	1,035	220	62.2
	28	5	15	1,325	238	79.6
	42	10	30	1,414	109	85.0
Polyester fiber	Control	...	25	2,082	191	...
	2	6	18	1,792	427	86.1
	4	6	18	1,383	221	66.4
	7	6	18	2,218	345	106.0
	14	6	23	1,917	334	94.9
	28	6	18	1,517	270	72.9
	42	6	18	1,717	304	82.5
Chromic catgut	Control	...	25	1,256	92	...
	2	6	18	1,067	224	85.0
	4	6	18	1,096	343	87.3
	7	6	18	1,334	145	106.0
	14	6	18	1,566	419	125.0
	28	6	18	643	429	51.2
	42	7	21	0		0

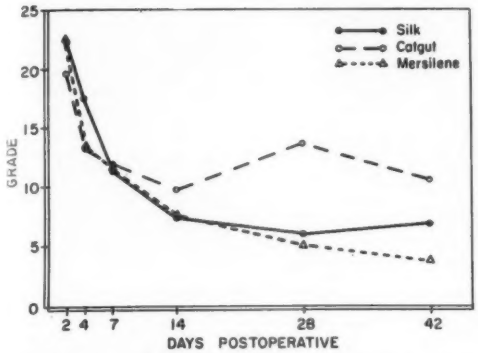

FIG. 1. Grade of tissue reaction is similar for silk and polyester fiber; catgut increases due to absorption.

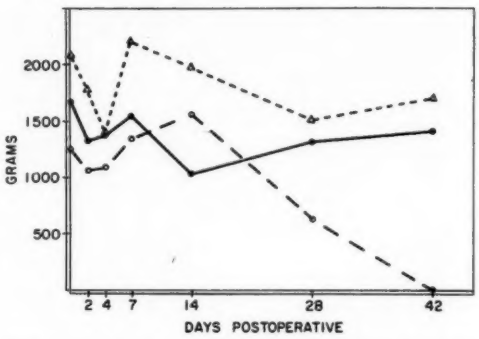

FIG. 2. Tensile strength of implanted suture. Silk and polyester fiber maintain tensile strength well. (Symbols are the same as in Figure 1.)

METHOD

Polyester fiber, black silk or chromic catgut (all No 3–0) were employed to close rectus wounds in rabbits. At the same time, long loops of the same material were implanted in the muscles of the abdominal wall. At intervals of two to forty-two days, biopsy specimens of the wound and the tissue about the implanted loops were taken, and the tensile strength of the wound and implanted suture determined. Hematoxylin and eosin stained sections of the wound and tissue were examined and graded blindly. The grade of reaction to the suture was determined by the type, density and area of cellular reaction and the rate and degree of fibrous tissue formation; criteria described by Sewell, Wiland and Craver [8].

RESULTS

The results are shown in Tables I, II and III and Figures 1, 2 and 3. The increase in tensile strength in the wounds followed the usual course. The histologic pattern of the healing wounds did not show any marked difference, although the reaction was slightly greater with catgut.

The tensile strength of the implanted suture loops showed that both the silk and the polyester fiber changed very little during the six week period of study. After absorption of the catgut began, the loss of tensile strength was very rapid; a marked decrease was present in twenty-eight days and the tensile strength was zero in forty-two days. The grade of tissue reaction decreased until absorption of the catgut began, and the resulting reaction to this absorption is reflected by the increased tissue response in twenty-eight and forty-two days. Silk and polyester fiber were remarkably similar until the latter part of the study when the lesser reaction to the polyester fiber became apparent. By the sixth week, and frequently earlier, the reaction to the polyester fiber usually consisted of only a layer of mature connective tissue surrounding the suture. The degree of reaction, however, was consistently a little greater than that previously found with Dacron and Teflon [9]. The polyester fiber suture handled well and the knot had no more tendency to slip than silk. The knots (a square knot with one added throw) in the rectus wounds did not untie during the period of observation.

TABLE III
GRADE OF TISSUE REACTION

Suture	Postoperative Day	No. of Animals	No. Graded (Sutures)	Mean Range (Animals)	Mean of Group
Regular silk	2	6	18	20.5–28.0	22.3
	4	6	31	15.8–21.5	17.6
	7	6	23	7.4–16.0	11.3
	14	6	28	4.0–11.5	7.3
	28	5	30	0.2– 8.0	6.0
	42	10	54	6.0– 8.2	6.9
Polyester fiber	2	6	25	19.0–26.5	22.8
	4	6	26	9.0–18.8	13.7
	7	6	31	8.0–15.5	11.5
	14	6	22	7.0– 8.2	7.5
	28	5	20	1.0– 9.8	5.0
	42	6	25	1.0– 6.2	3.8
Chromic catgut	2	6	29	14.0–21.7	19.6
	4	6	21	9.0–22.3	13.3
	7	5	23	9.0–14.3	12.1
	14	6	27	7.0–14.0	9.7
	28	6	30	5.2–21.5	13.7
	42	6	29	6.7–14.8	10.6

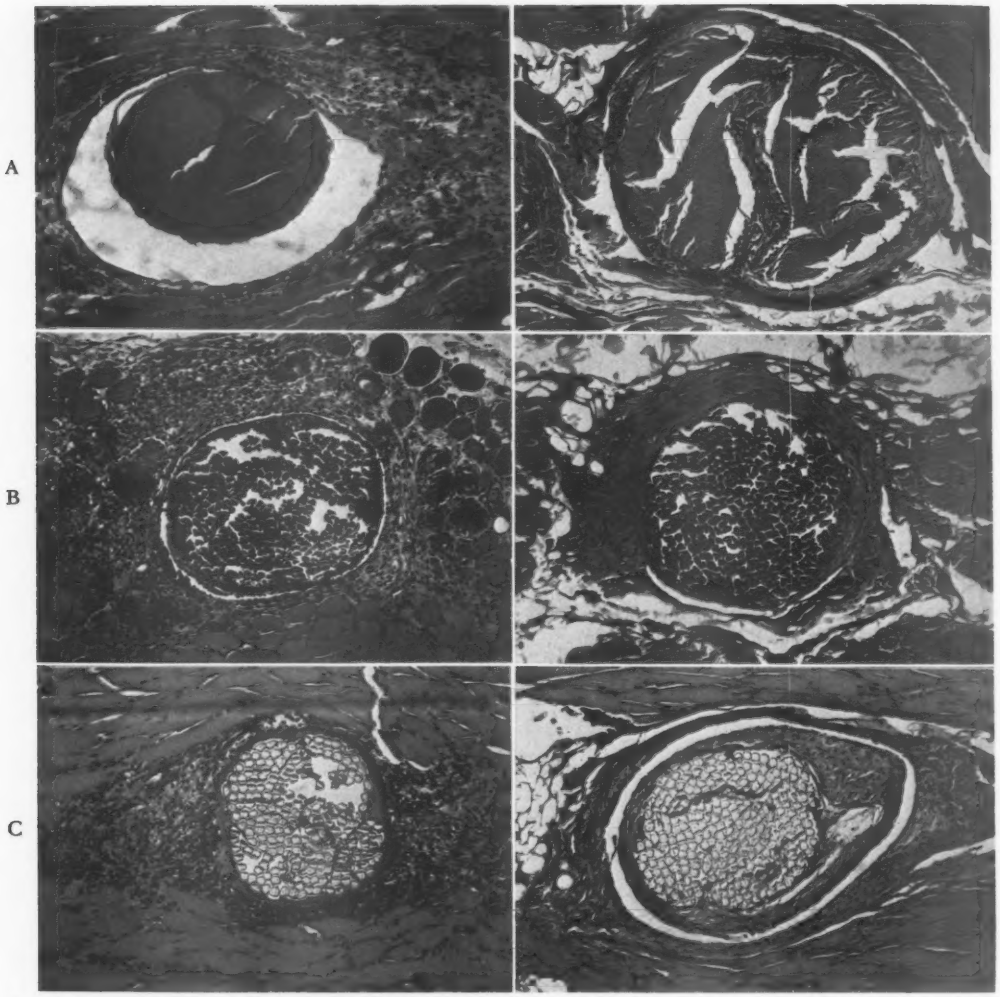

FIG. 3. Comparison of reaction to catgut, silk and polyester fiber (× 130). Left column, four days postoperatively; right column forty-two days postoperatively. A, early reaction to catgut similar to silk and Mersilene; late reaction, just beginning about this suture, is marked in areas while part of capsule is still fibrous tissue. B, silk shows a capsule of mature fibrous tissue; at about 5 o'clock a few fibers have separated from main mass of suture. C, polyester fiber suture is compact. Usually, a single zone of fibrous tissue is present but occasionally, a double layer as seen here.

SUMMARY

Polyester fiber as a surgical suture exhibited good handling properties, the ability to hold a knot, no untoward effect on the healing wound, maintenance of tensile strength in tissues, and a very low degree of stimulation to tissue reaction.

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CASE REPORTS

Surgical Management of a Recurrent Solitary Multilocular Nonparasitic Cyst of the Liver

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HUGE epigastric masses which produce pressure necrosis of the anterior abdominal wall are usually hopelessly advanced cancers of the stomach, pancreas or liver. Before despairing of the patients, the physician remains obligated to obtain an accurate diagnosis. The occasional patient may not have an inoperable malignancy. The case reported here is that of a patient who presented with an enormous fixed epigastric mass with extension through the abdomen wall and skin ulceration. Initially, the situation appeared completely hopeless but certain points in the patient's history suggested that this might be a benign neoplasm despite its clinical appearance.

CASE REPORT

CASE 1. M. C., a sixty-two year old white woman, first noted a painless lemon-sized mass in her mid epigastric region twenty-eight years previously. The discovery of the mass was incidental in that the patient had no associated symptoms. Later that year, a subtotal resection of the tumor was performed. The exact pathologic diagnosis could not be obtained but the patient said that she was told the mass represented a benign congenital lesion of the liver.

The patient remained essentially asymptomatic except for noting a persistent mass in the left

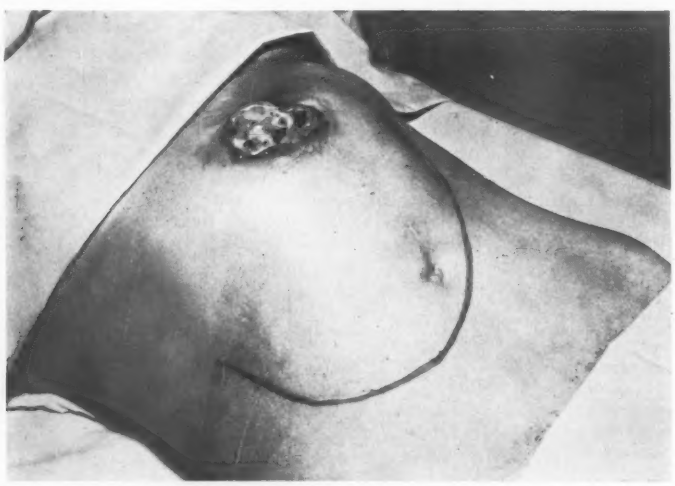

FIG. 1. The dark line delineates the tumor's lower border. The midline scar below the eroded area is from the previous excision.

upper epigastric region. In April 1960, the mass produced pressure erosion of the anterior abdominal wall in the mid portion of the previous incision. (Fig. 1.) From the eroded area spontaneous leakage of a yellow glycerine-like fluid occurred. The patient again sought medical advice. A biopsy of the protruding tissue yielded no exact diagnosis and she was referred to the Ohio State University Hospital surgical service for diagnosis and definitive therapy in July 1960.

On examination, pertinent findings were limited to the lungs and abdomen. Coarse breath sounds were heard throughout both lung fields, compatible with a history suggestive of chronic bronchitis. The abdominal findings showed a protruberant epigastrium with a 3.5 by 4 cm. ulcerated area. A knobby, firm, nonmovable mass was palpated from the umbilicus to the xiphoid, filling the epigastric region. Bowel sounds were absent in the right upper quadrant of the abdomen.

The initial laboratory tests included these: a complete blood count, urinalysis, blood urea nitrogen, fasting blood sugar, serology, Na, K, Cl, CO_2, serum amylase and liver studies. All were within normal limits except for an elevated alkaline phosphatase (normal 2 to 8 Shinowara Jones Rinehart units) of 12.6 units.

The x-ray examination included films of the posterior, anterior and lateral chest, intravenous pylogram, cholecystogram, upper gastrointestinal tract series and supine and upright views of the abdomen. All the films were within normal limits except for those included in the upper gastrointestinal examination which demonstrated that the stomach and intestines were displaced to the left. Needle aspiration biopsy failed to be diagnostic.

On the fifth hospital day the patient underwent surgery. Through a subcostal bilateral transverse incision the tumor was exposed. It was multicystic, approximately the size of a volleyball, and encapsulated by a dense fibrous sheath. The tumor was then freed from its attachment to the anterior abdominal wall and dissected down to its origin in the left lobe of the liver and removed. The hepatic triad was isolated. Varicosities of the portal veins and dilated bile ducts were noted. With sharp dissection the remaining capsule was excised from its origin and attachment in the

FIG. 2. Operative cholangiogram demonstrating dilation and displacement of the common bile duct and right hepatic lobe. The arrow indicates the normal position of the common bile duct.

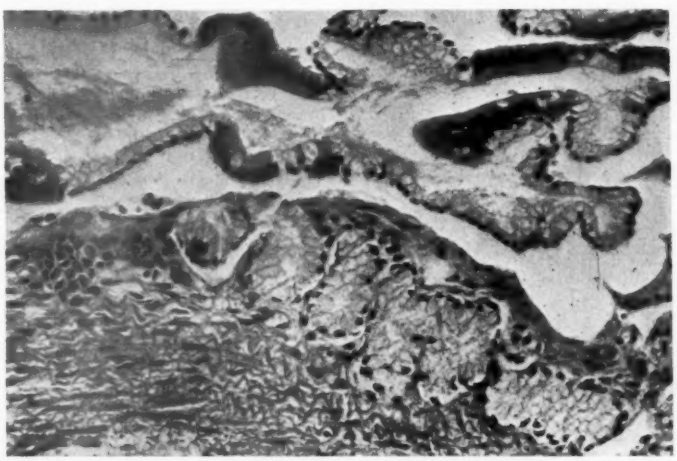

FIG. 3. Cuboidal cells in a ductlike pattern and columnar cells lining a cyst.

atrophic left lobe of the liver. The left hepatic artery, vein and bile ducts were isolated, ligated and severed. Hemostasis was then secured. The right lobe of the liver appeared normal in size and color but was displaced inferiorly into the right lower quadrant. The gallbladder contained one stone and was removed, as was the appendix. The results of the operative cholangiogram (Fig. 2) showed good reflux into the right lobe and immediate passage of the contrast material into the duodenum. The remaining abdominal viscera were noted to be grossly normal. Drains were then placed and the abdomen closed. The estimated blood loss of 1,500 cc. was replaced during surgery.

The patient's recovery was complicated by a severe pneumococcal pneumonitis that responded to penicillin therapy, and by a draining sinus tract in the right flank that by radiographic dye injection did not communicate with the biliary tree.

The gross appearance was a multilocular 12 by 18 by 13 cm. mass that was ovoid and brownish. Light gray septa were easily visible among the small cysts. The separate cysts were 1 to 2 cm. in diameter and contained a yellow glycerine-like fluid. A 0.5 to 1 cm. thick, glistening gray capsule surrounded the entire mass.

The microscopic sections showed multiple cyst walls lined with low columnar and cuboidal cells with an occasional goblet-like cell. (Fig. 3.) The base was constructed of both loose and dense fibrous tissue. The final pathologic diagnosis was solitary multilocular nonparasitic cyst of the liver.

COMMENTS

Solitary multilocular nonparasitic cyst of the liver is an uncommon disease which has often been inadequately managed since the first reported case in 1856 [1]. In 1906, Moschowitz postulated that this tumor resulted from aberrant bile duct proliferation due either to an inflammatory hyperplasia or to obstructive hyperplasia [2]. In 1922, Schaak formulated what is now the accepted definition of a solitary nonparasitic cyst by stating that the cyst must be single or present in only two or three isolated places in the liver, that it may be unilocular or multilocular and that it may be of any size [3]. Microscopically, the walls should consist of an inner cuboidal epithelial lining and three layers of connective tissue. The fluid may be of various colors and viscosities. In 1955, Geist reviewed the world literature and assembled 193 cases that could be classified as solitary nonparasitic cysts of the liver [4]. Later reports have raised this total beyond 200.

The diagnosis of congenital cysts of the liver is truly difficult to make unless there is a high index of suspicion. Usually there is a history of gradual enlargement in the upper part of the abdomen with development of a palpable mass which moves with respiration. The enlargement may be present for years without symptoms. X-ray examination is seldom diagnostic and liver function tests are usually normal. Many nonparasitic liver cysts produce no symptoms and are compatible with good health and a normal life-span.

When the cyst is large, however, and involves only one lobe of the liver (as is reported in about 90 per cent of these cases) total excision of the tumor or total lobectomy is recommended [4]. Improved surgical technics in recent years have permitted such procedures with low mortality and morbidity rates [5,6,7]. Since 1925, forty-six cases have been managed with either total excision of the tumor or lobectomy [4]. Among these patients two deaths have been reported and no associated morbidity.

SUMMARY

This is a case report of the successful management of a recurrent multilocular solitary nonparasitic cyst of the liver. The patient had a subtotal excision twenty-eight years before her symptoms recurred. The tumor was removed by total left lobectomy. She is currently in good condition, one year postresection. Total excision or total lobectomy is recommended as the definitive management of the solitary multilocular nonparasitic cyst of the liver.

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Actinomycosis of the Sigmoid Colon

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ALTHOUGH actinomycosis is well known to the profession, its infrequent occurrence may delay diagnosis. This is particularly true if the lesion occurs in an unusual location. In addition the nature of the disease makes its treatment extremely formidable, even with newer therapeutic methods. Reported herein is a case which illustrates difficulties in diagnosis and emphasizes some problems in treatment.

CASE HISTORY

CASE 1. A fifty-one year old white housewife entered the hospital on June 18, 1954, with a four month history of diarrhea (as many as twelve watery bowel movements per day). At no time did she notice bloody or tarry stools. The few formed stools she had were about the diameter of the little finger and light in color. At times, a mild diffuse abdominal discomfort was relieved by a loose bowel movement. She was generally tired, anoretic and had lost about twenty pounds. Two months prior to onset of this illness, her body was bruised in an automobile accident, but she did not think the bruises were related to her present complaints. Two weeks before admission, x-ray films obtained at another hospital showed a partially obstructive lesion of the sigmoid colon. Until this time, treatment had been primarily symptomatic for diarrhea.

Examination showed a well-nourished, comfortable woman with a temperature of 99°F. and a pulse of 72 per minute. In the left lower quadrant of the abdomen there was an indistinct mass which was slightly tender on deep palpation. The liver, kidneys and spleen could not be palpated. On rectal examination, the same indistinct mass could barely be reached by finger tip. The rectum felt smooth and the withdrawn finger showed no gross blood. A sigmoidoscope could be passed only 6 inches at which point a firm constriction was met, although the mucosa appeared normal and there was no intraluminal mass.

Laboratory findings were as follows: white blood cell count, 8650 per cu. cm.; red blood cell count, 3,800,000 per cu. cm.; and hemoglobin, 10.5 gm. per 100 ml. (68 per cent). Urinalysis revealed 10 to 15 white blood cells per high power field and a faint trace of albumen. The nonprotein nitrogen was 37 mg. per cent, the total protein 5.9 gm. per cent with albumen 4 gm. per cent and globulin 1.9 gm. per cent. Barium enema showed a completely obstructing lesion of the rectosigmoid, thought to be due to a neoplastic growth because of the well rounded proximal end of the barium column at the obstructing point. (Fig. 1.)

It was thought a colon resection would be necessary with the possibility of an abdominoperineal resection. A week after admission (following preparation of the bowel with neomycin), operation revealed an enlarged, thickened, indurated sigmoid colon with fixation to the left lateral pelvic wall and structures at the pelvic brim. The pericolic fat was indurated and reddened. The regional lymph nodes were enlarged but not unusually hard, and the surface of the liver was smooth.

In consultation with the pathologist (W. L. D.) diverticulitis was believed to be the most likely

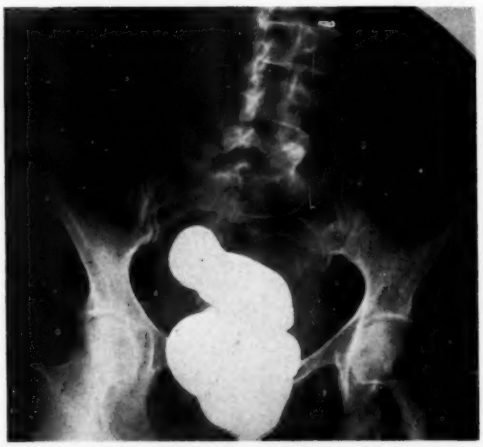

FIG. 1. Roentgenogram taken during examination by barium enema showing a completely obstructing lesion of the rectosigmoid. Note the well rounded proximal end of the barium column at the obstructing point.

FIG. 2. Roentgenogram taken during the last examination of the colon by barium enema in March 1959, showed no abnormality.

diagnosis. Anterior resection of the involved section of bowel was then performed. It was noticed that the sites of pathologic fixation were characterized by friable, granulomatous tissue that yielded readily, but it was impossible to perform a completely circumferential sharp dissection. The opened specimen showed several diverticular openings in the mucosa but no ulceration or tumor mass. Primary anastomosis was performed along with a decompressing cecostomy.

The immediate postoperative course was good; low grade fever which had been present prior to operation persisted for two weeks. On the fourth postoperative day, there was some redness and slight serous drainage from the midportion of the wound, which was opened further to facilitate drainage. A culture of the drained material in Sabouraud's medium did not reveal actinomycosis, but there was a fair growth of Escherichia coli. Drainage had almost ceased at the time of discharge on the twentieth postoperative day; the stools were well formed and the patient was afebrile.

PATHOLOGIC EXAMINATION

The resected sigmoid specimen, 18 cm. long and 4 cm. in diameter, had irregular puckering and induration of serosal fat. There was rigidity and thickening of the wall in the central three fifths of the specimen, the wall measuring up to 0.8 cm. (excluding subserosal fat). In the pericolic fat, there was a 3 by 4 by 2 cm. focus of green-brown softening of the fat suggesting a sinus tract, but it was confined by the serosa. Throughout the length of the segment, numerous small openings of diverticula could be seen.

Microscopically, small serpentine abscesses, bordered by granulation tissue and filled with pus, were seen in the focus of the green-brown softening described grossly. Characteristic mycelia of a fungus growth indistinguishable from Actinomyces bovis were present in the pus itself. Direct communication of this sinus tract with a diverticulum was not definitely established; it could have been closed by the overgrowth of peripheral granulation tissue. The mycelia had the usual lobular formation with central basophilic mattress of hairs extending radially to the periphery where clubbing of the acidophilic tips of hairs was seen.

POSTOPERATIVE COURSE AND TREATMENT

Treatment for actinomycosis was begun three days postoperatively. This consisted of saturated solution of potassium iodide given throughout the course of treatment beginning with 1 drop three times daily and increasing to 20 drops three times daily by the seventeenth day of treatment. Penicillin was given intramuscularly, 100,000 units every four hours for the first five days of treatment. Subsequently, Achromycin® (100 mg.) was given intramuscularly every twelve hours for eight days and then orally (250 mg.) every six hours thereafter. As an adjunct, two tablets of culture Lactobacillus acidophilus and bulgaricus were given three times daily to maintain the intestinal flora, as the patient disliked the taste of buttermilk.

After release from the hospital, potassium iodide, the oral form of Achromycin and the aforementioned culture tablets were prescribed for maintenance therapy. During this period, there was some looseness of stools and some pruritis ani which was relieved by local applications of vinegar. Two weeks later, the Achromycin was decreased to 250 mg. every eight hours and within ten days thereafter, well formed stools were occurring and the cecostomy tube was removed. By the tenth week after operation, all medication had been discontinued, the abdominal wound was nicely healed and the stools were normal.

Examination of the colon by barium enema four months after operation showed no abnormality. Subsequent barium enemas revealed a normal colon; the last barium enema was performed in March 1959, nearly five years after operation. (Fig. 2.)

COMMENTS

The pathogenesis of actinomycosis in this case is uncertain, but it may well represent a

complication of sigmoid diverticulitis. A report of 122 cases of abdominal actinomycosis by Putnam, Dockerty and Waugh [1] lends support to the theory that the causative agent, A. bovis, is invasive only when the normal barriers are destroyed by another disease process or trauma. In eighty-eight of their 122 cases, acute appendicitis, usually perforative, preceded the onset of abdominal actinomycosis. They also observed abdominal actinomycosis to follow perforated peptic ulcers, chicken bone perforations of the gastrointestinal tract, diverticulitis of the colon, perforated gall bladder and other perforative disease processes.

In reference to the cervicofacial variety of actinomycosis, Porter [2] has pointed out the relative frequency with which actinomyces has been isolated from the oral cavity, particularly in the regions of carious teeth, dental deposits and tonsils. He suggested that these areas may well be the source of infection. It is generally believed now that the causative organism is endogenous [1–3] and not exogenous from such sources as hay and straw as was once believed.

SUMMARY

1. We have presented an instance of actinomycosis of the sigmoid colon treated by resection of the sigmoid colon.

2. Penicillin, achromycin and potassium iodide proved effective in the postoperative management of this disease which was complicated by infection with Escherichia coli in the abdominal wall. No sinus developed from the site of the anterior resection.

3. Repeated follow-up by means of barium enema for nearly five years showed no evidence of recurrent infection.

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Torsion of the Normal Ovary

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So much emphasis has been placed on the hazards of a diseased ovary becoming twisted and infarcted that it is virtually unknown that the same may occur in a normal ovary. It is such an unusual occurrence that textbooks do not even mention it and rarely, if ever, is it discussed in the diagnosis of problematic surgical abdomens. The rare instance of torsion of the normal ovary precipitates the urgent picture of an acute condition within the abdomen. On the right side, it is usually mistaken for acute appendicitis. On the left, the problem is more disconcerting and is handled with considerable hesitancy. This paper records one case of torsion of the normal ovary in a child and presents a brief review of the literature.

CASE REPORT

A ten year old white female child was admitted to the hospital complaining of pain in the left lower quadrant of about eight hours' duration. The pain was severe, nonradiating and constant, but with intermittent sharp exacerbations. It seemed worse when lying and was partially relieved by sitting up. She felt nauseated but did not vomit and had two normal bowel movements during the day. There was no diarrhea, chills or urinary symptoms. The menarche had not yet occurred. The patient had had measles, mumps, chickenpox, tonsillitis, pneumonia at the age of eight weeks, asthma since the age of six years and numerous allergies.

Physical examination revealed an ill, well developed, obese child with flushed facies. Temperature was 100°F., pulse 120 per minute and respirations 20. Blood pressure was 100/60 mm. Hg. General physical findings were noncontributory, but local examination of the abdomen revealed marked tenderness and spasm in the left lower quadrant, and while the remainder of the abdomen was somewhat resistant, palpation referred pain to the left lower quadrant from all other parts of the abdomen. The liver, spleen and kidneys were not palpable. Bimanual rectal examination set up increased muscular resistance, so that the examination was not entirely satisfactory. There was marked tenderness in the cul-de-sac with a suggestion of a mass on the left side. Hemoglobin was 12.8 gm. per 100 ml.; white blood count, 11,000 per cu. mm.; and urinalysis, negative. Plain films of the abdomen and a chest plate showed no demonstrable abnormalities. An enema of saline solution was returned relatively clear.

The child was re-examined under general anesthesia and the presence of a small mass in the left lower quadrant confirmed. Laparatomy revealed a left ovary twice the size of the right. The left ovary was twisted on its pedicle with infarction of the ovary and severe congestion of the tube. Although there was slight recovery of the ovary after the twist was released, the organ appeared to be so severely damaged that a left salpingo-oophorectomy and incidental appendectomy were performed. The child made an uneventful recovery and left the hospital on the eighth postoperative day.

Pathologically the specimen was described as follows: The specimen consisted of a totally resected ovary together with the attached tube. The ovary had been sagittally split and measured 4 by 2.5 by 1.5 cm. The serosal covering retained a grey pearly quality, but was thin and permitted visualization of the underlying intensely red-blue hemorrhagic engorged ovarian stroma. The cut surface had almost the appearance of a coagulated blood clot. Dispersed throughout this stroma were small red focal areas of increased consistency which appear to have been small cysts now filled with hemorrhagic coagulated fluid. These cysts averaged 3 to 4 mm. in diameter. There was no single large cyst or tumor and the ovary appeared to be either in a state of early hemorrhagic infarction or extremely intense vascular congestion. The tube was somewhat engorged but less hemorrhagic than the ovary and it measured 6 by .5 cm. The serosal surface was slightly granular due to

TABLE 1

PERTINENT INFORMATION ON PATIENTS WITH TORSION OF THE NORMAL OVARY

Author	Age (yr.)	Recurrence of Illness	Constipation	Nausea and/or Vomiting	Duration of Symptoms (days)	Temperature (°F.)	Pulse	White Blood Cell Count (1,000)	Peritoneal Fluid	Side of Torsion	Palpable Mass	Organ Involved	Clinical Diagnosis
Hartman [1]	20	No	Yes	Yes	1	...	...	...	...	Right	...	Tube and ovary	Appendicitis
Norris [2]	19	No	Yes	Yes	4	98.0	136	9.4	None	Right	Yes	Ovary	Appendicitis, ?torsion
Cassidy [3]	11	Yes	No	Yes	6	100.2	120	...	Bloody	Left	Yes	Tube and ovary	None
Barrington [4]	38	...	No	Yes	1	...	...	...	Clear	Right	Yes	Ovary	None
Monroe [5]	11	...	...	Yes	5	101.5	120	...	...	Right	Yes	Tube and ovary	None
	10	Yes	...	Yes	9	102.0	120	...	...	Right	Yes	Ovary	Appendicitis
Cohen [6]	13	...	Yes	Yes	4	102.8	100	17.8	Bloody	Right	...	Ovary	Appendicitis
Rost [7]	½ mo.	No	Yes	Yes	7	101.0	120	...	Bloody	Right	...	Ovary	Appendicitis
Downer [8]	7	No	No	Yes	1	98.6	90	13.0	Bloody	Left	...	Ovary	None
Northcutt et al. [9]	7	Yes	Yes	Yes	4	101.0	128	25.0	Bloody	Right	No	Ovary	Appendicitis
Baron [10]	9	Yes	Yes	Yes	5	...	...	...	None	Left	Yes	Tube and ovary	Torsion of ovary
Hicken et al. [11]	8	Yes		Yes	2	101.8	110	21.0	Bloody	Left	Yes	Tube and ovary	?Appendicitis, ?torsion
Neel et al. [12]	3	Yes	Yes	Yes	2	...	...	20.1	Bloody	Left	...	Tube and ovary	Appendicitis
Fowlie [13]	10	Yes	No	Yes	2	99.0	112	17.9	Bloody	Left	...	Tube and ovary	Appendicitis
Gould [14]	2	No	No	No	2	99.2	123	11.5	Serous	Right	No	Ovary	Appendicitis
Conf. [15]	7	Yes	Yes	Yes	1	101.0	120	13.2	Bloody	?	...	Tube and ovary	?Appendicitis
Taylor [16]	11	...	Yes	Yes	5	99.4	...	20.0	None	Right	No	Tube and ovary	None
Robins [17]	26	...	...	...	4	98.0	84	8.0	...	Left	No	Tube and ovary	Torsion of ovary
	20	Yes	...	Yes	3	98.8	90	15.8	...	Left	No	Tube and ovary	None
Sieber [18]	3	No	...	...	3	100.0	110	18.5	Bloody	Right	Yes	Tube and ovary	Appendicitis
	½	No	...	Yes	5	100.0	...	11.0	...	Right	Yes	Tube and ovary	None
Manos [19]	3	No	...	Yes	1	98.6	...	12.4	...	Right	...	Ovary	None
Hinshaw et al. [20]	6	Yes	Yes	Yes	5	99.0	120	Normal	...	Left	Yes	Ovary	None
Sarason et al. [21]	7	Yes	Yes	Yes	2	101.0	128	12.9	Bloody	Left	No	Ovary	Appendicitis
	10	Yes	No	Yes	3	101.0	120	18.0	Bloody	Left	Yes	Tube and ovary	None
	23	No	...	...	10	99.6	84	11.1	Bloody	Left	Yes	Ovary	None
	34	Yes	Yes	Yes	1	99.8	...	15.0	Bloody	Left	No	Ovary	None
	5	Yes	Yes	Yes	...	Up	...	Up	Bloody	Left	Yes	Tube and ovary	Appendicitis
	13	Yes	No	No	1	...	...	16.6	Bloody	Right	No	Ovary	None

the engorgement. There was no evidence of involvement of the fimbriae and no fusion.

Microscopic examination revealed the ovarian substance to be extensively hemorrhagic. This hemorrhage was of very recent origin and consisted of large lakes and masses of coagulated blood in some areas, while in other regions, there was diffuse permeation of underlying ovarian stroma by the recent hemorrhage. There was no evidence of luteinization or of previous ovulatory reaction and no suggestion of other abnormality or tumor within the ovary.

COMMENTS

The first case of torsion and infarction of the normal ovary was reported by Hartman in 1898 [1]. A thorough search of British and American publications uncovered an additional twenty-eight cases. The files of the Boston City Hospital's Mallory Institute of Pathology do not contain even a single case. Reports of twisted fallopian tubes without ovarian involvement are slightly more numerous. We elected to review only cases with ovarian pathology and a summary of the pertinent features are presented in Table 1.

Torsion of adnexal structures may involve the tube, the ovary (in this situation the distal tube is also damaged), and both the tube and the ovary. The mechanism of torsion has been attributed by various authors to a long mesosalpinx or mesovarium, the persistence of a spiral uterine artery, variations in intra-abdominal pressure due to cough, hiccough and straining, and finally to changes in body position.

In the majority of instances, torsion of the normal ovary occurred during the first two decades of life. Four patients had been in the gravid state. Abdominal pain, vomiting and constipation were the more constant and most prominent symptoms. The pain appeared suddenly, became localized in either lower quadrant of the abdomen and usually was described as sharp. About a half the patients spoke of similar illnesses with spontaneous recoveries in the past. A low grade fever associated with tachycardia and leukocytosis was a common finding. The right and left ovaries were involved with approximately the same frequency. In every patient, the site of abdominal pain, tenderness and muscle spasm corresponded with the side on which the twisted ovary was found. A palpable mass, on rectal examination, was described in thirteen cases.

It is not surprising that the most frequent preoperative diagnosis with right-sided torsion was uncomplicated appendicitis, and perforated appendicitis with peritonitis when the process affected the left ovary. Subtle differences in the clinical pictures of torsion of the adnexal structures and acute appendicitis merit emphasis. In torsion, repeated short bouts of abdominal pain, nausea and vomiting with spontaneous remission may occur. This presumably corresponds with torsion and release of torsion of the affected ovary. Unlike appendicitis, the pain is sharp and becomes localized immediately, without preliminary migration, in either lower quadrant. In addition, the duration of symptoms in infarction of the ovary is slightly longer (average 3.7 days with a range of one to eleven days) than in acute appendicitis. The presence of a pelvic mass, especially on the left side, may tip the scale against the diagnosis of appendicitis. Even with incomplete data, two-thirds of the patients are reported to have bloody fluid in the peritoneal cavity. Therefore, an abdominal tap, essentially an innocuous procedure, may on occasions be instrumental in making the correct diagnosis.

SUMMARY

1. One case of torsion of a normal ovary in a ten year old child is reported and a review of the literature presented.

2. The outstanding diagnostic features of torsion of the normal adnexal structures are discussed.

Acknowledgment: We would like to thank Dr. Stanley L. Robbins for the pathologic description.

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Reconstruction of a Large Defect on the Entire Thickness of the Chest Wall

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THE basic principles of cancer surgery dictate wide excision of the diseased area with *en bloc* removal of the tumor, surrounding tissues and draining lymph nodes when feasible. Surgical reconstruction is the second phase of the operation.

The surgery of repair of the anterior thoracic wall following cancer procedures has a long history with singular problems. The advent of radical mastectomy in 1894 by Halsted was the keynote for an aggressive attack on carcinoma of the breast. Standard mastectomies require the removal of large amounts of surrounding skin along with the breast. Once the excision is complete, the problem is how to close the defect without producing tension at the suture line, the tension being the precursor of many complications. Soupoult [*11*] and Gruca [*3*] described thoracic abdominal flap rotations to breech the gap between the straining suture lines. Schepelmann in 1924 used an advancing flap of the opposite breast, splitting the breast to get extra width.

The increased understanding of pulmonary physiology, the antibiotics and advances in thoracic surgery have allowed the surgeon to carry out a more radical attack on the initial or recurrent cancer of the breast. Ribs, cartilage, sternum and the lung itself are removed, if the possibility of a cure is ascertained. Removal of the ribs or sternum affects the stability of the thorax, giving rise to paradoxical motion with its corollary complications, pneumothorax and hernias of the lung. Fascia lata, tantalum plate or latissimus dorsi flaps have been advocated as suitable substitutes to span the deficiency in the chest wall.

A unique and difficult problem exists when there are both a large soft tissue defect and a bony defect with which to cope. The situation demands prompt fixation of the ribs for respiratory movement and function and soft tissue continuity. Beardsley [*1*] resected the sternum and skin and stabilized the chest by using tantalum plate. He rotated the entire right breast as a flap to cover the tantalum. Pickrell et al. [*8*] described the closing of a resected rib flaw, using fascia lata, and rotated a breast flap as soft tissue covering.

It is the purpose of this paper to present a case of recurrent carcinoma of the breast which eventually involved skin, chest wall and the lung. The course of therapy is outlined.

CASE REPORT

The patient was a fifty-four year old white woman who was first seen by one of us (G. W. P.) on February 5, 1953, with a chief complaint of "drawing and scabbing of the right chest for one year." The patient stated that ten years prior to the visit a right simple mastectomy was performed for carcinoma of the breast. Two and a half years following the operation, the patient underwent removal of a subcutaneous "lump." (The diagnosis and location were unknown.) Three, four and five years following initial surgery, the patient received x-ray therapy to the right anterior chest wall. During the year prior to her initial visit, drawing pain and an ulcer of the right anterior chest wall developed.

Physical examination was negative for abnormalities except for atrophic, glistening skin with telangiectases over the right side of the chest. An irregular, ragged ulcer and eschar were present over the right anterior chest wall, measuring 1.5 cm. in diameter, with raw edges and a depressed center. There were no palpable masses in the axilla or surrounding subcutaneous tissue.

On February 10, 1953, with the patient under general anesthesia, the ulcer and a portion of the radiated skin were removed to the rib cage. The resultant defect was closed with a very large, superior lateral based flap, moved inward to close the space. The postoperative course was uneventful.

The pathologist's report was recurrent adenocarcinoma of the breast at all margins, fibrosis and dense scar with radiation effect. We advised resection.

The patient was lost to follow-up study and treatment until March 3, 1954, when she presented again with a chief complaint of ulceration of the right chest wall. Since the rotation of the flap the previous year there had been a continual breakdown and ulceration and healing of tissue.

Physical examination revealed the scar from the previously rotated flap on the right chest wall, with an ulcer measuring 0.5 by 0.5 cm. in the skin. (Fig. 1.) There was purulent drainage from the ulcer. Marked telangiectases of the skin surrounded the flap. On March 9, 1954, the ulcer and surrounding tissue were widely removed and split grafts applied. Postoperative course was uneventful. The pathologist reported adenocarcinoma of the breast in the subcutaneous tissue with radiation dermatitis.

The patient presented herself on May 9, 1955, with multiple firm nodules over the anterior chest wall. The nodules had a central ulceration, measuring 1 cm. in diameter. On May 11, 1955, with the patient under general anesthesia radical en bloc excision of the right anterior chest wall was performed by Dr. Thomas Wiper. (Fig. 2.) Limits of excision consisted medially of the lateral one-third of the sternum on the right side, superiorly from the second costal cartilage and rib to inferiorly through the fourth costal cartilage and rib, and laterally to the anterior axillary line. The lung was adherent to the chest wall in this area. The middle lobe and anterior segment of the upper lobe were included in the en bloc dissection. The specimen measured 12 by 12 by 2.5 cm. A mat of No. 40 stainless steel mesh was sutured in place to close

FIG. 1. Recurrent carcinoma is visualized as an ulceration on the right anterior chest wall. The surrounding skin shows the usual skin changes following x-ray therapy for carcinoma.

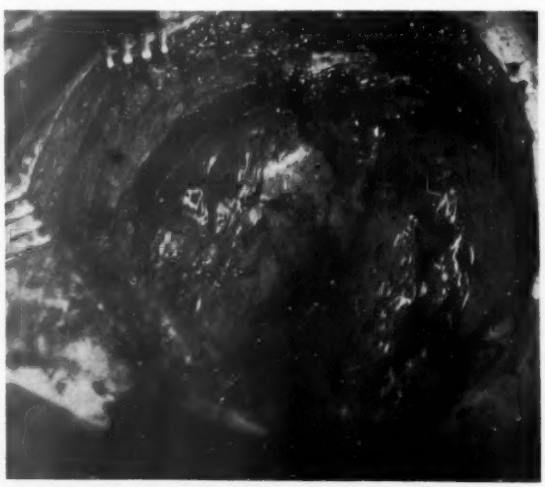

FIG. 2. A wide en bloc excision of the diseased area was performed leaving the defect to be reconstructed.

FIG. 3. The first stage of reconstruction was the fixation of the thoracic cage with a mat of No. 40 stainless steel mesh.

FIG. 4. View from the right lateral chest showing the left breast transposed directly above the stainless steel mesh and fixed to the soft tissue above the thoracic cage.

FIG. 5. The breast flap has healed and there is no evidence of recurrence of tumor twenty-two months after the en bloc excision of the involved right anterior chest wall. The split thickness skin graft used to repair the donor site of the flap is apparent on the left thoracic wall.

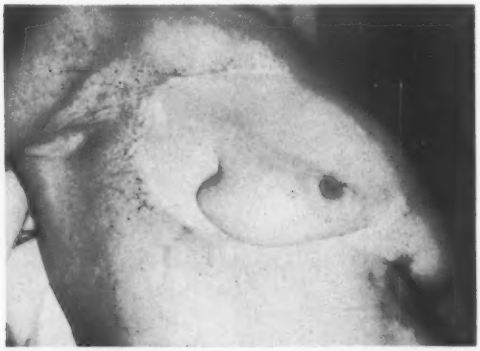

FIG. 7. Lateral view taken four and a half years after radical excision.

FIG. 6. Division of the breast into two segments has been performed and this photograph was taken four and a half years after radical excision.

the defect and give stability to the thoracic cage. (Fig. 3.) The plastic team then outlined a flap consisting of the entire left breast and 4 cm. circumference of skin. The flap was based superiorly at the infraclavicular area. The flap was rotated and sutured in place over the wire mesh. (Fig. 4.) A split graft was used to close the donor site of the flap. (Fig. 5.) In the pathologic report the specimen was adenocarcinoma of the chest wall and skin with all margins free of tumor.

On the eighth postoperative day, under sterile conditions in the operating room, the bulk dressing was removed. There was a 100 per cent take of the flap and a 90 per cent take of the skin graft. On the twelfth postoperative day, right pleural effusion developed which was treated by removal of 250 cc. of serosanguineous fluid. There was no pneumothorax. There were no other significant postoperative complications.

On March 24, 1957, the patient had a revision of the breast flap with division of one-third of the breast. On June 23, 1957, further division of the flap and revision of scars were performed.

At the time of this writing, sixteen years since simple mastectomy and five years since radical excision were performed the patient is free of disease. The steel mesh is still intact.

SUMMARY

A case is presented of recurrent carcinoma of the breast involving the right anterior chest wall. Local excision failed to eradicate the disease. Radical excision of the chest wall and a portion of the lung was performed with success. Reconstruction of the chest wall was performed using stainless steel mesh and rotation of the entire left breast as a flap. There was complete healing in the face of radiated tissue and a foreign body.

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Tumors of Major Peripheral Nerves

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PERIPHERAL nerve tumors usually involve small nerve branches and may be excised with little loss of function. Their rare occurrence in major nerves, however, presents numerous difficulties in pathologic diagnosis and treatment which will be illustrated here in five cases.

CASE REPORTS

CASE I. A forty-five year old Negro woman was admitted to the hospital with the chief complaint of a lump in the left axilla of one and one-half years' duration. Prior to admission she noted occasional pain down to the fingertips of all the fingers except the thumb. Physical examination revealed an exquisitely tender, slightly movable 2½ cm. mass in the upper left arm near the axilla. It was not attached to the skin but was attached to the underlying structures. The involved area was explored under ether anesthesia and a tumor of the radial nerve was found which appeared to involve the entire trunk of the nerve. A biopsy was made of the tumor and the nerve injected with alcohol. The biopsy report (S39-678) was "Perineural Fibroblastoma." Approximately a week later the patient was taken again to the operating room and the tumor excised, including a section of the normal nerve on either side of it. The pathology report (S39-753) was "Perineural Fibroblastoma Encapsulated." Subsequently the patient had a complete radial nerve palsy which was treated by dynamic splinting.

The unfortunate but needless disabling palsy produced in this patient introduces the diagnostic and therapeutic complexity of such tumors and evokes numerous questions. What is a perineural fibroblastoma? If it was encapsulated, why was it not shelled out? If one had to resect it, why was the nerve not resutured? If this was impossible, why was not a tendon transfer performed to ease the patient's burden? We hope these questions will be answered in the discussion of the cases presented here.

CASE II. A seventy-eight year old woman was admitted to the hospital with a 3 cm. mass in the inner aspect of the right arm which was partially fixed to the deeper structures. The patient was operated upon and the tumor was found to be attached to the right median nerve. The capsule of the tumor was opened longitudinally and the mass excised without damaging the nerve. Following surgery there were no neurological sequelae. The pathology report (S51-2537) was "Perineural Fibroblastoma" or "Benign Encapsulated Neurilemmoma."

The *benign encapsulated neurilemmoma* is the most common variety of nerve tumor and it usually forms a round or fusiform mass located in connection with smaller nerve twigs or within the sheath of a major nerve. The tumors are usually firm and white although occasionally they may be cystic and of a jellylike consistency. Microscopically, the tumor is made up of long slender cells with the nuclei arranged in a palisade fashion, the so-called Verocay body or Antoni A. areas. (Fig. 1.) In other parts of the same tumor the tissue may appear to be a loose reticulum of cells with small nuclei and radiating fibrils with minute areas of cystic degeneration. These are the so-called Antoni B. areas (Fig. 2) which are most prominent in the acoustic nerve tumors.

These tumors are usually solitary and rarely become malignant. Their origin is open to debate with various authors favoring the fibroblast [*1,2*] and others the sheath of Schwann [*3,4*]. Thus there are many pseudonyms of this tumor: neurilemmoma, acoustic nerve tumor, acoustic neuroma, angioneurofibroma, false neuroma, fibroglioma, fibromyxoma, glioma, myoschwannoma, neurilemoblastoma, neurinoma, neurofibromyxoma, perineural fibro-

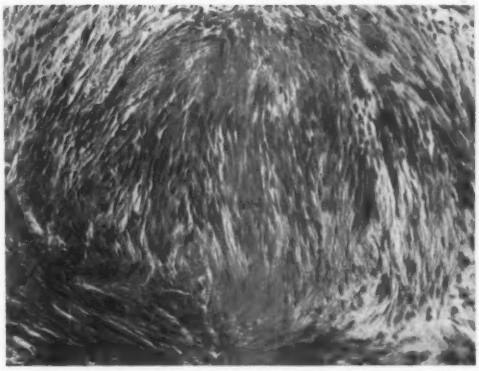

FIG. 1. Microscopic section of neurilemmomas showing palisading of nuclei, the so-called Verocay body or Antoni A. areas.

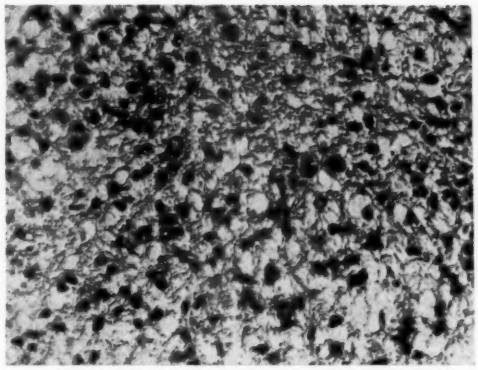

FIG. 2. Microscopic section of neurilemmoma showing a loose reticulum of cells with small nuclei and radiating fibrils, the so-called Antoni B. areas.

blastoma, Schwannoma, peripheral glioma, perineural glioma. Even when apparently located in the center of a major nerve, they can be shelled out of a rather well defined capsule.

CASE III. A fifteen year old girl was admitted with a nontender swelling of the right side of the neck. For about a month she had noticed loss of hearing in the right ear together with a ringing sensation and an earache. Two weeks before admission she noticed lumps under her arms. Examination revealed several masses: one in the right side of the neck about 3 inches in diameter which was nontender, not attached to skin, and which protruded into the posterior pharyngeal wall; another 2 inches in diameter in the right axilla; and numerous tender masses on the inner aspect of the upper left arm and on the dorsum of the left middle finger. Neurological examination revealed the right pupil to be larger than the left with a bilateral nystagmus, a left internal strabismus and bilateral edema of the optic discs. There was marked atrophy of the tongue which protruded to the right. The left ankle jerk was absent, the left knee jerk was diminished and the patient fell to the right when the eyes were closed. Spinal fluid pressure was 290 with a total protein of 216, sugar at 57, chlorides at 717, and a 2+ Pandy, with 40 white blood cells in the spinal fluid. A diagnosis of multiple fibromatosis was made. The patient was taken to the operating room where a mass in the ulnar nerve of the left upper arm was excised, which was followed by a complete left ulnar nerve palsy. The pathology report (S41-191) of this tumor was "Perineural Fibroblastoma" or "Benign Encapsulated Neurilemmoma." Subsequently, the patient was transferred to the division of neurosurgery where a right acoustic neuroma was successfully removed.

This case again illustrates a mistake in judgment in not attempting to remove the ulnar nerve tumor from its capsule. Even if enucleation were not possible and a resection had to be performed, the ulnar nerve should have been sutured since gaps up to 12 cm. can be overcome by freeing the nerve widely and translocating it anterior to the medial humeral epicondyle.

This case also illustrates the fact that some patients may have multiple neurilemmomas and each tumor can be removed according to the principles mentioned. However, when multiple tumors are present, they must be carefully distinguished from the tumors found in von Recklinghausen's disease.

CASE IV. A twelve year old Negro girl with von Recklinghausen's disease came to Boston in 1957 during the influenza epidemic and died within several days with a cough and fever. The pathology report (A57-943) revealed massive involvement of numerous nerve trunks: the trigeminal, vagus, brachial plexus, celiac plexus and intercostal. There was a huge mediastinal neurofibroma in the right chest which in "dumbbell" fashion had grown into the upper six or seven intervertebral foramina. There were also numerous mucosal neurofibromas of the colon and small intestine. The skin demonstrated elephantiasis neuromatosa over the entire back, neck and both arms. Numerous café-au-lait spots were found on the abdomen and lower legs. Death was due to acute interstitial viral pneumonitis proved by positive viral studies and demonstration of antibodies against this virus.

In von Recklinghausen's disease there are multiple nerve tumors each of which shows a

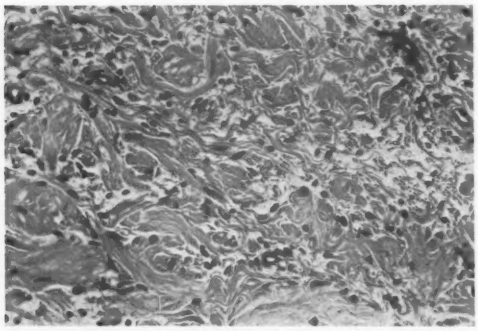

FIG. 3. Microscopic section of neurofibromas demonstrating collagenous fibers and fibroblasts encompassing nerve fibrils.

diffuse proliferation of neurites and Schwann cells. Antoni A. areas are rarely present. There is much hyperplastic connective tissue (Fig. 3) which causes a thickening of the nerve and separates the individual nerve fibrils, sometimes producing a pressure atrophy. Such a tumor is called a *neurofibroma*. Special stains will show the nerve fibrils passing through the proliferating sheath cells. These changes are found in the sympathetic as well as in the peripheral and cranial nerves. Extensive involvement of nerves may produce a marked tortuosity known as *plexiform neuroma*. Proximal growth may extend through the intervertebral foramina to involve the spinal cord. Other stigmata of von Recklinghausen's disease may be present such as fibroma mollusca, café-au-lait spots, sebaceous adenomas, lipomas, intestinal tumors, bone deformities and meningiomas. Synonyms for this type of tumor are plexiform neuroma, dumbbell tumor, elephantiasis neuromatosa, fibroma molluscum, hour glass tumors of the spine, multiple neurofibromatosis, multiple neuroma, neurinomatosis, neuroblastomatosis, neurofibromatosis, neuromatosis, von Recklinghausen's disease.

These tumors have a high potential for malignancy. Inadequate excision may stimulate their growth either along the nerve or as a metastasizing malignancy. Spontaneous sarcomatous transformation has been estimated to occur in 13 per cent of von Recklinghausen's disease [5]. Extirpation has been followed by sarcomatous changes in distant neurofibromas or by the development of neurofibromas elsewhere in the body. The relative hopelessness of the future of this group probably dictates that surgery be done only for tumors which undergo a rapid growth or present cosmetic or functional disabilities. The surgery consists of wide nerve excision and not enucleation.

It is to be remembered that benign encapsulated neurilemmomas may occur also in von Recklinghausen's disease and since they have a low potential for malignancy may be handled as the other neurilemmomas.

CASE V. A fifty-six year old white man was admitted with a painless lump in the left axilla of six months' duration. Examination revealed a 4 by 3 cm. mass in the left axilla which was slightly tender, movable and not attached to skin. No neurological disturbances were noted. The patient was taken to the operating room where a biopsy of the mass was obtained under local anesthesia, and it was found that the tumor appeared to be fixed to a major nerve. The pathology report (S56-2382) was "Benign Neurilemmoma." This diagnosis was made because an Antoni B. area was discovered in the specimen. About one week later the patient was again taken to the operating room where the mass was explored and found to be a part of the proximal portion of the radial nerve. The tumor was easily dissected from the surrounding tissues, but it could not be separated from the nerve and no well defined capsule could be developed. The tumor was accordingly excised with the involved radial nerve proximally and distally to where nerve tissue appeared normal. This left a gap of approximately 5 inches on the radial nerve. Despite the fact that the radial nerve was freed proximally into the brachial plexus and distally to the elbow, end to end approximation could not be attained. As a consequence, a subperiosteal resection of the medial two-thirds of the clavicle was carried out and the nerve ends were then approximated with the arm adducted on the chest. The patient was immobilized for four weeks in this position and eventually discharged from the hospital with a dynamic splint. The pathology report (S56-2555) was "Low-grade Malignant Neurilemmoma with Invasion of the Capsule." Three months later the patient returned to the hospital and a tendon transplant was performed to correct the extensor palsy in the hand. Subsequently the patient developed excellent function and there has been no evidence of recurrence of the tumor for three years postoperatively.

This case presents several interesting points. What is to be done with a solitary major tumor which cannot be shelled out of its capsule? In most cases a generous excision of the nerve can be done since reanastomosis can be performed even if there are large nerve gaps. This is possible through mobilization of proximal and distal nerve beyond adjacent

joints or the rerouting of nerves [6,7]. In the present case the excision of the clavicle permitted the nerve ends to be approximated. Even if reanastomosis is not possible, several of the tendon transfers offer a very useful substitute [8].

What should be the procedure if the tumor is so large that a reanastomosis is impossible and the involved nerve is one for which there is no good tendon transfer? Then, a generous biopsy should probably be performed and, if benign, the lesion should be left alone. A needle biopsy has been advocated by some surgeons. It seems, however, that the pathology of this tumor is too complicated for this and such a small biopsy could be misleading [9]. Indeed, this has already proved to be the case [10].

About one-half of malignant neurilemmomas are associated with von Recklinghausen's disease. Microscopically, the sheath cells grow in cords, often in a whorling design resembling a fibrosarcoma. In addition, capsule invasion, anaplasia, mitoses and bizarre giant cells are found in the more advanced malignancies. Antoni A. or B. areas may be seen in some of these tumors suggesting their derivation from encapsulated neurilemmomas.

These malignant tumors grow proximally along the nerve trunks into adjacent tissue or metastasize by blood stream. Synonyms for these tumors are neurogenic sarcoma, neurofibrosarcoma, malignant neurinoma, malignant peripheral glioma.

Treatment depends upon the local findings. If there has been spread to adjacent tissues, an amputation will be necessary plus a dissection of the involved nerve for 12 to 15 inches proximal to the tumor. If there is no spread to adjacent tissue, a generous excision of involved nerve should be made, the length to be removed depending on the histologic evidence of the grade of malignancy.

There are malignant peripheral nerve tumors which resemble tumors of the central nervous system: neuro-epithelioma, medulloblastoma, medulloepithelioma [11]. These are exceedingly rare but highly malignant and capable of blood stream metastases. Treatment would be similar to the malignant neurilemmoma.

SUMMARY

A series of five cases has been presented to demonstrate some of the features of tumors of major nerves. When operating upon a patient with a single tumor, an effort should be made to discover whether or not it is encapsulated. If it appears to have a definite capsule and it can easily be enucleated from the nerve, this is probably the best treatment since in this instance one is dealing with a benign encapsulated neurilemmoma. If the tumor is not encapsulated and it is believed that the resulting nerve gap can be reanastomosed or if it is attached to a nerve for which there are suitable tendon transfers, an excision of the tumor should be made. If, however, these conditions are not met, then a generous biopsy of the lesion should be performed to see whether or not it is malignant. If it is benign, it is probably best to leave the lesion alone if the resultant palsy would be severely incapacitating. On the other hand, if it is malignant, one must excise the nerve widely. If the nerve tumor is found to be growing into adjacent tissue, an amputation of the extremity will be necessary together with a wide nerve dissection.

Multiple nerve tumors are treated according to the same principles unless there are stigmata of von Recklinghausen's disease in which instance it is probably better to leave the tumor alone unless it is growing very rapidly or presenting cosmetic or functional disability.

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MEDICO-LEGAL REPORTS

The Stomped Pancreas Death

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THIS case of fatal rupture of the pancreas from "stomping" at the end of a fight presented interesting problems both to the surgeons who cared for the victim and to the lawyers who prosecuted and defended the assailant. The presentation is based on a "CPC" for the House Staff at Kern County General Hospital, and on a preliminary hearing in the Bakersfield Municipal Court.

SUMMARY OF CLINICAL HISTORY

CASE 1. This forty year old white man was brought in by ambulance in the early morning following a fight. There were multiple abrasions and contusions on the head and face, and two superficial abrasions on the upper abdomen. His speech was slurred and he appeared obviously intoxicated. At no time did the subject give any detailed account of the fight. However, later investigation indicated that he had been knocked unconscious and that as he lay on his back on the ground his assailant "stomped him." The stomping included a jump onto the middle of the abdomen. He was kept in the emergency room for five hours. Although he vomited a little coffee-ground material shortly before his release, this was not considered a remarkable reaction to ingestion of blood.

He returned in the afternoon complaining of continued vomiting. It was rather clearly established that there had been no additional trauma between release and readmission of the patient. At the time of readmission the significant findings were abdominal distension with diminished bowel sounds and tenderness and guarding of the right lower abdomen.

His serum amylase was 381 units per 100 ml. on admission and 365 units per 100 ml. the next day. Fluid drawn on abdominal paracentesis showed 623 units of amylase per 100 ml. Hemogram indicated the following: hemoglobin 16.9 gm. per cent; white blood cell count, 14,500 per cu. mm.; segmented neutrophils, 61 per cent; and stabs, 15 per cent. The x-ray films were reported as showing no free air within the abdomen. Spinal fluid was clear with pressure of 175 mm. of water.

His condition steadily deteriorated; about twenty-seven hours after readmission, it was decided that an exploratory operation should be performed. Exploration revealed extensive fat necrosis of the omentum but no rupture of the intestine. His heart action languished and a thoracotomy was performed for cardiac massage. The patient was kept alive by artificial respiration, but was pronounced dead approximately forty hours after his readmission. The clinical diagnosis (from the House Officers and the Hospital Record) was nontraumatic pancreatitis.

CLINICAL DISCUSSION

James Colt (Surgeon). We have a case of a forty year old man who was brought to the hospital approximately four to six hours following an altercation in a bar. Apparently he suffered multiple abrasions and contusions about the head and face and two abrasions over the upper portion of the abdomen. On admission, the patient appeared to be intoxicated and his breath smelled of alcohol. The history given later revealed the patient had been knocked unconscious and while lying on his back his assailant stomped him. "Stomping" in this area means literally to walk heavily over the victim. The upper abdomen was the area in which the stomping was concentrated.

After five hours of observation, it was the House Officer's opinion that the patient had improved

enough to be sent home. Before leaving, he vomited coffee-ground material (cuts in the mouth were observed).

Approximately twelve hours after the incident and four to six hours after release the patient was readmitted; he was vomiting and had abdominal distention.

To go over some of the points which are already apparent, when anyone is unconscious following a blow to the head, he must be observed for intracranial hemorrhage and for edema. (At this point, Dr. Colt posed a number of questions to the House Officer; the following information was obtained.) The pupils were round, equal and reacted to light and accommodation on both admissions. Blood pressure and pulse were not changed and were adequate. No blood was seen behind the drums or in the ear canals during examination on either admission. There was no recurrence of unconsciousness. X-ray films revealed no pulmonary pathology (pneumothorax, hemothorax or hematoma). No decrease in the hematocrit, hemoglobin or red blood cell count was observed. Injury to the head or thorax can fairly well be ruled out. X-ray films of the skull were also negative for fracture.

At the time of the second admission, the patient was in worse condition than when discharged. He now had diminished bowel sounds with tenderness and guarding in the right lower portion of the abdomen as well as abdominal distention and vomiting. These symptoms and findings suggest a violent reaction of the intestinal tract to trauma. Probably the trauma of the stomping caused a certain amount of direct trauma to the bowel. In view of the pain in the right lower quadrant, I believe the patient had drainage from the upper abdomen into the pelvis. The elevated levels of amylase in the blood and peritoneal fluid indicates pancreatic trauma. (When questioned, the House Officer denied that there was discoloration of the flanks or the area around the umbilicus which occurs when blood in quantities is in or under the peritoneum [Cullen's sign].) An abdominal series did not show increasing amounts of fluid between the loops of the small bowel. Also, there was an indication of paralytic ileus with gas in the small and large bowel.

I believe with these findings that rupture of the pancreas must be used as a working diagnosis. Usually the amylase level is near 1,000 units per 100 ml. of aspirated peritoneal fluid of a patient with ruptured pancreas, but this patient's condition closely resembles that of a patient with acute hemorrhagic pancreatitis. Both have chemical peritonitis with extreme irritation of the peritoneum and abdominal organs. The attempt of the irritated serous surfaces to wash away the irritant causes an out-pouring of 2 to 3 L. of high protein fluid similar to plasma. Such patients have an initial blood volume deficit and with this superimposed bleeding of plasma there is an even greater deficit which is much the same as we see in patients with intestinal obstruction. Shock due to hypovolemia is pending. The fat saponification found at surgery shows evidence of activated pancreatic juice. This in turn results in calcium deficiency which will result in a relative increase in potassium. It is well documented that there are Clostridium organisms in the human pancreas and liver. Rupture of either organ will result in release of these extremely virulent bacteria. Rapid involvement of the peritoneum will occur. These organisms will cause protein digestion very quickly which will produce extremely toxic products from the protein breakdown. There is an increase in the peritoneal weeping due to this irritation and further hypovolemia. The patient's intake of ethanol caused stimulation of the secretion of acid which stimulated the secretion of secretin and then in turn caused stimulation of the secretion of pancreatic enzymes.

All of the aforementioned set the stage for disaster when the insult of an anesthetic and surgery was added. In my opinion, cardiac arrest occurred because of hypovolemia, low calcium, relatively high potassium and toxicity due to the peritonitis and protein breakdown products.

There is an analogy between a patient with acute hemorrhagic pancreatitis and this patient, and I believe the following procedures should have been carried out. The blood volume should have been determined and plasma volume reconstituted; the electrocardiogram and serum potassium possibly would have shown hyperkalemia. Measurement of the level of serum calcium would have helped to determine if there was a deficit. Antibiotics in large quantities, preferably penicillin and streptomycin, would have helped to control the bacterial invasion. Levin decompression would reduce the secretogogue effect of the acid from the stomach. Though there is controversy of these points, I would consider surgical intervention with drainage of the peritoneal cavity and washing of same with normal saline. Definitive drainage of the pancreas might perhaps be tried by inserting a small plastic catheter in the open ends of the pancreatic ducts and bringing them to the outside for suction. (The pancreas secretes under pressure and I am sure this pancreas was in a secretory phase.) Suction type drainage for a time might have relieved the leakage until definitive and more extensive surgery could be performed.

This type of case demands exploration and the mortality rate is high, but the possibility of salvage might be greater with early active care as described.

My diagnosis is traumatic rupture of the pancreas with peritonitis, hypovolemia and calcium deficiency with relative potassium increase, all of which set up the cardiac arrest.

AUTOPSY FINDINGS AND DISCUSSION

Robert W. Huntington, Jr. (*Pathologist*). There was extensive peritoneal fat necrosis. A linear contusion of the stomach with a break in the serosa parallel to the long axis of the body was located 2 cm. proximal to the pylorus. Just adjacent to this was a similarly oriented 2 by 2 cm. split in the head of the pancreas, about 4 cm. from the duodenal margin. The pancreas adjacent to the rupture was contused. Microscopic examination of a section taken through the fracture line showed fibrinous and polymorphonuclear exudate along this line. Toward the head of the pancreas from this line was necrosis and fat necrosis with venous thrombosis. The section, through the pyloric "linear contusion" confirmed the suspicion in the gross examination that this was actually a split of the serosa and muscularis.

The pancreatic and pyloric injury could be readily visualized as possible sequelae to a jump with one foot on either side of the vertebral column. With mere contusion of the pancreas it might not be possible to state that the process was undoubtedly traumatic [*1*]. The problem, however, does not arise with the laceration in this particular case; there were no major medicolegal problems after the autopsy. The absence of major damage to the abdominal wall is not at all unusual [*2–4*].

Medically, the diagnosis might perhaps have been suspected in the ward if a more accurate history of the fight had been available. More consideration should perhaps have been given to the ethnic group of victim and assailant. Stomping must be conceded to be a characteristically Okie modality, and one might, therefore, look for an elevated incidence of nonvehicular pancreatic trauma in this group. If the possibility of pancreatic trauma had been more seriously considered, perhaps the pancreas might have been adequately inspected at the time of surgery, despite the major difficulties and harassments. Certainly exploration would have been considered earlier.

Anatomic Diagnoses. The anatomic diagnoses were as follows: incomplete rupture of pyloric region; traumatic rupture of pancreas; necrosis of pancreas due to trauma; fat necrosis of peritoneum; terminal bronchopneumonia; and cardiac arrest (clinical).

LEGAL COMMENTS

Fred Owen (*Prosecutor*). In the case of the People versus "A," the defendant was charged with killing one "B" on April 26, 1960. After evidence was presented at the preliminary examination, the defendant pleaded guilty to the crime of involuntary manslaughter, based on the unlawful killing of B, without malice, in the commission of an unlawful act not amounting to a felony, to wit: Battery.

The evidence presented at the preliminary examination established that the deceased, B, on the night of April 24, 1960, became involved in an argument with a third party in front of a bar where B had been drinking quite heavily. While B was involved in this altercation, in which no blows were struck, he was approached from behind by the defendant who struck him on the side of the head, knocking him down and apparently unconscious. While B was on the ground on his back and unconscious, the defendant moved a short distance from him, then ran back and jumped in the air coming down with his feet on B's abdomen. The defendant then left the scene. B was transported to the hospital where he died two days later, on April 26, 1960.

The evidence also indicated that the deceased was addicted to the excessive use of alcohol and that he had, at one time, been a professional boxer. Dr. Robert W. Huntington, Jr., the pathologist for Kern County, testified that he performed an autopsy on B on April 26, 1960, and determined that the cause of death was generalized diffused peritoneal fat necrosis, due to traumatic rupture of the pancreas. He further testified that this traumatic rupture of the pancreas could have been caused by the blow delivered by the defendant when he jumped on the deceased's abdomen.

The argument presented by the defense, through cross examination of Dr. Huntington, was that the aforesaid blow to the abdomen was not the cause of death, but that the defendant died as a result of nontraumatic pancreatitis. This argument was supported by the fact that the pancreatitis could have resulted from excessive use of alcohol. It was further supported by the fact that traumatic pancreatitis was an admittedly unusual result to expect from a blow of the nature of that delivered in this case.

However, a photograph was taken at autopsy, under the direction of Dr. Huntington, which clearly illustrated a 2 by 2 cm. split in the head of the pancreas. Also shown in the photograph was a bruise on the stomach at a point which would be directly above the split in the pancreas when the defendant was lying in the position in which the evidence proved him to be at the time the blow was delivered.

This photographic evidence fully supported Dr. Huntington's testimony that the cause of death was, in his opinion, a traumatic rupture of the pancreas which should, in my opinion, remove the problem of reasonable doubt in a trial before lay jurors that the death of B was caused by the blow to the abdomen delivered by the defendant, A.

Milton Younger (*Defense*). A, the defendant in this case, who was originally charged with murder, eventually pleaded guilty to the lesser included offense of involuntary manslaughter. Testimony

that A had cause to fear an imminent attack upon himself, the existence of "hot blood" associated with the long-standing feud between the parties and the reputation of the victim (an ex-boxer) as a "brawler," combined with the medicolegal problems presented, weakens the prosecution's charge of murder. Included in the medicolegal problems is the failure of staff members of the hospital to diagnose correctly and treat the victim's condition upon his first admission. The correlation between hemorrhagic pancreatitis and the prolonged excessive drinking in which the victim had indulged and the testimony that only the flat bottom of a shoe, as opposed to a less blunt instrument, had inflicted the allegedly fatal blow makes the defendant guilty of manslaughter only.

DISPOSITION

The assailant pleaded guilty to involuntary manslaughter.

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Malpractice: A Primer for the Medical Defendant

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Abstract of paper read before the Los Angeles Urologic Research Congress, Los Angeles, California, November 7–11, 1960.

THIS paper is a primer for physicians and their counsels. It outlines ways to avoid malpractice suits, tells what to expect in court, and tells what has happened in other cases. It is based on the views of 255 jurors who were interviewed immediately after the end of the trial by professional investigators as to the reasons for their verdict, opinions of the doctors, lawyers and other jurors.

Malpractice suits have become so common that they are now recognized as a definite occupational hazard of the medical profession. It is estimated that they cost $50,000,000 a year. They are a real threat to the standard of medical care, in that doctors will be deterred from exercising their best medical judgment as to using, in seriously ill patients, experimental but potentially helpful treatments and technics. Caution is a virtue in medicine but it can be overdone.

Malpractice does not mean a doctor's failure to render the best possible care to a patient; it does not mean an honest error in judgment; it means simply the failure of a physician to apply the average skill of those in his community and to take average precautions in rendering his professional services.

The primary purpose of malpractice insurance is to protect a patient who has been mistreated.

The cases with merit are set up for settlement. Those considered without merit are tried, and there is no compromise unless the defendant requests such.

We differ from the legal profession in that lawyers believe that there is a legal basis for a suit if the person *thinks* a mistake was made, even if no malpractice or damage results; hence, the patient should be paid, and the attorney permitted to collect a fee. Whereas, the medical profession believes that the plaintiff should be required to post a bond, when suit is filed, and if there is a defense verdict the defendant should be compensated for the damages incurred by such a false suit. If that was so, there would be fewer suits.

Do not say, "It can't happen to me." One of every four members of the American Medical Association in New York and California, and one of seven in the United States, have been sued for malpractice. If you have been lucky so far, you may be "tagged" tomorrow.

Keep your old insurance policies, since a child can sue one year after he reaches twenty-one for any injury received prior to that time. In certain states suits may be brought at any time after the patient discovers, or had a reasonable opportunity to discover, the negligent act causing damage. The policy in force at the time of the alleged malpractice applies to such suits, not the current one.

Who Are Sued and Why. An eminent superior court judge said, "I have never had a family doctor in my court as a defendant in a malpractice case." The explanation is that they establish a closer relationship with their patients and are frank about mistakes; if there is a cut ureter they tell the patient, and do not leave it to the consultant to do so, and refer most difficult cases to a specialist.

In case a patient complains of slow progress, or there is an intimation of possible malpractice, (1) watch what you say, be sympathetic and noncommunicative, (2) notify your insurance carrier at once and give them all pertinent facts, both favorable and unfavorable, (3) have your records show all procedures, particularly advice to the patient to come in for checkups, and (4) have consultations.

If for some reason you do not want to continue to treat a patient, send him to another doctor. There was a judgment of $3,000 against one doctor who made the mistake of merely refusing further treatment to the patient without referring him elsewhere.

Preparation of Records. Histories should be taken in the third person. If any changes are made in either office or hospital records, do not erase; draw a line through the offending sentence and date the interlinear addition. Write all orders on the chart and sign them. Original hospital records have to be produced in court, because photostats do not show erasures.

Suits are frequently won or lost because of the condition of such records. A large verdict in favor of the plaintiff was rendered in one case because the hospital records were altered and all laboratory reports were not available for introduction during the trial.

In another case there was a $75,000 verdict because of an incomplete record. A 100 pound box of meat was dropped on the claimant's foot, and he eventually lost his left leg. The sketchy records did not disclose the man's previous confinement for arterial insufficiency in a teaching hospital.

An alcoholic addict was operated upon by a resident and subsequently eviscerated. Primarily because of the poor records containing undated late entries, the verdict was $20,000 against the hospital.

The instant you learn you have been sued turn your file unstripped over to the insurance carrier to photostat. Later, before a subpoena is issued for your office records, you can remove extraneous matter. Then there can be no question of the accuracy of your records.

Deposition. A deposition is merely a "fishing expedition." The plaintiff's attorney is looking for evidence to support his case and something to be used to impeach your testimony. You are under oath, but he is not. The deposition may or may not be made part of the case.

Your attorney will instruct you to tell the truth, and that you have to answer all questions because the plaintiff's attorney is entitled to an answer to each question. Then he leaves you "on your own" and merely watches out for the law. You should answer *yes* or *no* to most of the questions and not explain. If the question is tricky, and if the answer is "No," qualify it with either, "I have no recollection, I do not remember, I do not recall, I have no knowledge, or My assumption is." The plaintiff's attorney can force no further answer. Before you give a deposition it would be worthwhile to read the transcript of testimony given by Sherman Adams before the House Special Subcommittee on Legislative Oversight, as reported in *U. S. News and World Report*, pages 78 to 92, June 27, 1958. If your deposition is brought into court you can then explain your answers to the jury.

The plaintiff's attorney wants you to talk, hoping that you will say something that he can elaborate against you. He will have your records, and you will have a photostatic copy. He will ask you what you did on a certain day, and after refreshing your memory by looking at your copy, you read what is written there. His next question will be, "What does that mean?" Your answer should be, "The record speaks for itself." Legally you are required to answer his questions—and you have.

It is not unusual for a defendant to break mentally and physically under the stress of a gruelling malpractice deposition that continues for many hours. Recently after such a session, a diplomate of the American Board of Urology on the staff of a government hospital in Oakland, broke and took the short way out—suicide; the U. S. Government, not he, was the principal in the suit.

Trial. Selection of jury: "Juror Service" furnishes sheets to their subscribers, giving court background of each name on the jury panel.

During the trial, if an insurance company is mentioned by name a mistrial results because the jury is supposed to believe that the defendant bears all costs of the trial.

As to the qualifications of the ideal juror, the opinion of jurors themselves is rather illuminating. They state that the best are those between the ages of thirty and forty, who are employed and have served on juries before. Among undesirable jurors for the defense are old people, both women and men, because they are sympathetic with the plaintiff, and tend to be very charitable with other people's money. Those who are retired tend to give money awards to the insecure. Avoid those who have no authentic address, are unintelligent, illiterate, deaf, emotionally unstable, and those who are retired service nurses, since

they are prone to feel superior to civilian doctors.

Jury or judge: Do not expect a trial by a jury of your peers as guaranteed by the Magna Charta and our Constitution. In the Federal Court the Jury Commissioner screens the jurors, but in the Superior Court they take the "run of the mill," all who are registered voters, instead of going into their personal lives and selecting people of intellectual ability to serve. Doctors are responsible for furnishing excuses to many of the intelligent members of the panel; therefore, frequently the "flotsam and jetsam" of the city sits as your peers. Investigators who interview jurors after trials are routinely unable to locate some of them. In one case, seven jurors were unknown at the address given or had moved leaving no forwarding address.

Plaintiffs' attorneys say that if they have a good case they prefer to try it before a judge, but if it is weak they want a jury, so as to attempt to sway them with emotion.

Attorneys: Some plaintiffs' attorneys are much more interested in fees than justice and are skilled at making doctors appear in a bad light in court. The plaintiff's lawyer can file suit even though the patient, who has been persuaded to sue, refuses to sign the complaint. The plaintiffs' attorneys' fees in Superior Court are usually 50 per cent but may be only 35 per cent of the net judgment, after subtraction of legal costs. To the defendants' attorneys the trial is merely another chore at about $200 a day in court and $20 an hour out of court. They protect the doctor so far as the law is concerned, but appear helpless to shield him from the slanderous allegations of the plaintiff's attorney, who is not under oath. The defendant must hold his tongue, for fear of prejudicing his case before the jury.

Courtroom procedure: The defendant may be called by the plaintiff's attorney as his first witness; but, he is not bound by the witnesses' answers. The judge is the moderator and also the thirteenth member of the jury, for if he does not like the verdict he may set it aside and grant a new trial. Your attorney's duty is to see that your legal rights are protected and watch for mistakes that will warrant a new trial or appeal.

Few lawyers are competent to try a malpractice case alone. The defendant or one of his experts should sit with the attorney to make sure that no favorable medical fact is overlooked and no questionable statement is not challenged and corrected.

You know that you are innocent of the charges, wasting time in a court room and neglecting your patients, and hence you are antagonistic to the plaintiff's attorney; but you must remember that in the eyes of the jury you are a malefactor, and they expect you to be dignified rather than bored or arrogant, even though you are being subjected to an extortionist's inquisition.

Pay no attention to the lawyers except to listen to their questions. Do not argue with the plaintiff's attorney, no matter how much he tries to belittle and irritate you. Talk to the jury. Keep your eyes on them but do not stare. Play no favorites; direct your answers to each one in turn. Some of the plaintiff's attorneys are fine cultured gentlemen, but others are the reverse and will attempt to put "words in your mouth" and try to make you lose your temper.

When possible, answer his questions, "Yes" or "No." Then explain your answer to the jury. When using medical terms explain the meaning of such terms in lay language, give bare facts, and leave no room for argument; use few words, make what you say count, but do not elaborate. He will probably complain to the judge that you are arguing and making a speech, so make sure that you are merely clarifying in detail your answer.

Recognize no book or person as authority for the treatment rendered or operation performed. You are the authority. Remember always that the medical or surgical procedures used were based on your training, experience and what you learned at refresher courses and medical conventions. The law of evidence in most states specifies that only the opinion of an expert witness, who can be cross examined, can be used as authoritative. A book cannot be introduced unless the witness acknowledges his familiarity with it and bases his opinion wholly or in part thereon.

You will be asked if you are being paid to testify; wait about thirty seconds until all are listening, and then say, "I have been asked to come here in order to divulge the contents of my record of treatment of the patient. I never charge for such testimony." When testifying as an expert your answer should be, "I charge not for testifying, but for the amount of time

I am away from my practice, and the time spent in research."

If the judge refuses to allow you to read your records, you can say you do not remember and ask the privilege of consulting them to refresh your memory. That can go on endlessly.

Do not leave the jury with the impression that you are being evasive or are concealing something. The truth, even if it is against you, is better than evasiveness. The jury is charged that if any part of the testimony of a doctor is believed to be false, they must disregard his entire testimony.

A wise plaintiff's attorney is probably familiar with all that you have written, and with all the books you have taken from the local medical libraries since you learned that you were going to be sued. If your testimony differs in any way from what you have published, follow the precept of John Hunter who said, "Never ask me what I have said or written, but ask me what my present opinions are and I will tell you." Say your opinions have changed in the light of your later studies or experience.

What influences the jury: The use of technical terms prejudices the jury; they want matters explained in plain words. There was a verdict for $35,000 in one case, primarily because of the use of technical terms by the defendant.

A judgment of $55,000 was awarded because the defendant's expert appeared to be evasive, having been confused by the attorney.

One jury agreed that "it was not what the defendant said but what he did not say." A defendant who was "deceitful and dealt in half truths" lost his case.

Large colored charts or plastic models are very impressive and most helpful. Do not depend upon an amateur free-hand sketch on the blackboard, for it will not be drawn to scale. The plantiff's expert may be a poor doctor, but a professional experienced court witness with an ingratiating manner who will deny the accuracy of the blackboard sketch. In one case, if a regulation chart been used and the particular blood vessels copied from it, there would not have been a plaintiff's verdict of $80,000. The jury was convinced by the plaintiff's professional expert, a suave neophyte of small attainments, that the distinguished professor had lied. Incidentally, you would be amazed at how many attorneys have copies of Lederle's beautiful loose-leaf Atlas of Normal Anatomy.

Both defendants and plaintiffs have lost cases because they did not talk loudly and could not be heard or understood.

Expert witness: The purpose of expert testimony is to provide the average lay juror with the facts covering the points at issue. He must testify that the standard of care was maintained as that of an ordinary careful practitioner in that particular community.

A general practitioner can testify as an expert. All that is needed is a physician and surgeon's license, experience and general knowledge of the field. An osteopath may testify as an expert.

A practitioner from a small town was a plaintiff's expert in a very technical case. Because he was merely a country doctor he was believed to be honest, and his testimony was accepted against those of two outstanding Board specialists.

Any doctor who has acquired information about a patient can be forced to testify as to facts with a $2.00 subpoena. However, no doctor can be forced to give an expert opinion except for an appropriate fee. An expert can refuse to testify on the grounds of inconvenience and/or inadequate remuneration.

Character witness: A person's opinion as to the defendant's reputation for veracity, honesty and integrity in the community is not admissible irrespective of how well and how long he has known the person, unless he has heard his reputation questioned.

Type of charges (other than malpractice): One of the most common causes of suits is a misunderstanding about fees. Never sue for collection of a bill until the statute of limitations has expired. Be sure the statute has run, or the patient has been treated for the condition by another physician, or that the patient knew of his condition more than a year prior to filing suit for collection of the bill. An old aphorism that is aproposis is, "Doctor, collect thy fee while the patient aileth, for then thou art a god. If he recovers thou art a thief. If he dies, thou art a murderer."

The statute of limitations for malpractice in California is one year. The time begins when the claimant *learns* of the alleged mistake. Judges frequently leave the determination of time to the jury, and then too often fail to charge them that if a year has passed after the patient learns of the alleged malpractice they should bring a verdict in favor of the defense.

You may be sued for malpractice but really tried for one of a variety of other causes where the statute of limitations may be as much as four years. Representative cases of each follow:

Assault and battery, or failure to get proper consent: No expert testimony is needed, and the doctor is responsible for all damages resulting from the alleged assault and battery, although he was not negligent.

1. A common complaint is making any kind of examination without the patient's permission, such as taking blood for an alcoholism test, at the request of a police officer, or performing diagnostic cystoscopy for an insurance company.

2. A patient who was violently opposed to spinal anesthesia had noted on his chart that he did not want a "needle in the back"; however, he agreed to an epidural anesthesia, not knowing what it was. He developed a paraplegia. The jury said, "No malpractice," only assault and battery, and awarded $95,000. The verdict was set aside on grounds of insufficient evidence. At the second trial the verdict was for $97,000. One sixty year old woman on the jury was unsuccessful in her attempt to add $30,000 for impotency.

Negligence of doctors, assistants, hospitals, or nurses:

1. Bed rails should be ordered by the doctor for patients over sixty-five and all others under sedation, and such orders should be written on the chart. Also, bathroom privileges should be cancelled when a patient has been given sleeping medicine. A plaintiff's verdict for $32,500 was awarded a patient who fell out of bed postoperatively.

2. In view of the fact that the courts have ruled that spinal puncture is foolproof, a paralysis following such is prima facie evidence of negligence. For a paralysis that occurred three months after a spinal puncture, a federal judge awarded $220,000.

3. The California Supreme Court ruled in a suit predicated on an alleged infection, with fever, following a cystoscopy, that the passage of a sterile cystoscope could not cause infection since such must have already been present, and rendered a defense verdict. Hence, the term "postcystoscopic infection" is a legal misnomer in California and should no longer be used as a "catch all" term to explain a genitourinary infection—and promote malpractice suits.

4. A cystoscopy nurse poured isopropyl alcohol instead of Skiodan® for pyelograms. Four centimeters was injected into each kidney pelvis and immediately washed out. Later another urologist passed catheters with ease to each kidney.

In court the defendant's expert was asked by the plaintiff's attorney if, although it was *standard practice* to depend upon the accuracy of the trained cystoscopy nurse, was it *good practice?* His reply was that doctors were taught in medical school that it was good practice to read the labels on bottles before injecting any material; whereas, in private practice they generally rely on the nurse. That destroyed the defense and ended the trial; a settlement of $70,000 was made.

Errors in diagnoses: A child while running for a school bus fell and hit his head. He was taken to a hospital, although apparently uninjured. Skull x-rays were made and the findings being negative for abnormalities, the mother requested to be allowed to take the child home; she was told to watch him carefully. The next morning there was sudden death which the coroner attributed to a brain hemorrhage. The doctor was sued for $100,000 for failure to provide a careful diagnosis or call a specialist as a consultant.

Errors in judgment: A lesion of the tongue was removed by means of a cautery knife; the biopsy was negative for abnormalities, and tests were repeated annually. Ten years later the patient went to another doctor who removed one-half the tongue; cancer was found but no evidence of metastases. The result would have been the same, but it was difficult to convince a jury that failure to detect the cancer earlier was not negligence. The case was settled for $25,000 for error in judgment.

Fraud and deceit: When danger of a procedure is not fully explained, the patient's signed consent is valueless.

1. A patient had a slight x-ray burn that healed promptly. Another doctor thoughtlessly told her that it might ultimately result in cancer. The jury gave a $15,000 judgment for the cancerphobia.

The Supreme Court of Kansas has ruled that a doctor who has a poor surgical result and has failed to make a substantial disclosure to the patient of all the possible bad results prior to treatment, although he received inferred consent, is guilty of malpractice. An oral

explanation without a witness is not sufficient; better still is written evidence.

Breach of warranty is the common allegation in unsuccessful vasectomies when the wife becomes pregnant. These call for big sympathy judgments. The defendant is asked to pay for medical costs, loss of service of the pregnant woman, and care of offspring until it reaches the age of twenty-one. However, vasectomy continues to be a popular Saturday afternoon office operation for some neophytes. (According to the English common law, the basis of our laws, sterilization is mayhem, and consent for such cannot be given, and there has been no contrary ruling by a higher court.)

Vasa ligation at the time of prostatectomy has comparatively recently become routine with many urologists; in the years I was connected with Johns Hopkins Hospital, I never knew Dr. Hugh H. Young, the father of modern urology, to perform one. It is a procedure fraught with legal danger.

1. Several years ago a seventy-five year old man underwent suprapubic prostatectomy and vasa ligation performed by a resident urologist. Both he and his wife, after an explanation, signed the consent slip for both operations. Shortly thereafter he brought suit against the resident and the chief of urology because he had been sterilized. The case was tried without a jury before a judge, and he ruled that age and not the operation had sterilized the plaintiff and rendered a verdict in favor of the defense.

2. Recently, following a transurethral resection, the operator was sued for not explaining to the patient and his wife that he would be sterilized although they both had signed the consent slip. The Superior Court judge threw the case out of court. The Supreme Court ruled that the matter had to be presented to a jury. At the second trial there was a defense verdict. Shortly thereafter the medical expert witness of the defense was sued under similar circumstances. His insurance company settled the case out of court without his knowledge.

3. A man in Fresno with six children on relief underwent vasectomy at his request and that of his wife, and at the instigation of the welfare agency. The proper consent slips were signed. A few years later the wife died, and her family took the children. The man got a good job in the shipyards and married a young girl who wanted a baby. The accommodating doctor settled the case out of court for $30,000.

4. A cholecystectomy was contemplated. On exposure no disease was found, so the gallbladder was not disturbed. The patient was not told and paid the bill of $450. Later another surgeon removed the gallbladder. The jury brought in a verdict of "no malpractice" but gave judgment of $10,000 for breach of contract. Incidentally, the doctor's insurance, according to a fine print exception, did not cover damages for breach of contract.

Foreign bodies: When such an accident happens, explain the facts to the patient but do not take any blame yourself or blame anyone else.

1. A suprapubic fistula did not heal. Roentgenograms showed an opaque shadow. The doctor told the patient of the foreign body and gave him the sponge and the x-ray films as souvenirs. The patient paid his bill and promptly sued. The judge warned the jury that if they brought in a defense verdict he would set it aside. The verdict was $7,000.

2. A diplomate of the Board of Urology (who belonged to no urologic societies) left a sponge in a bladder. He testified that he had never heard of "sponge counts." The verdict was $20,000, and obviously the attorney could not appeal.

New Trial and Appeals. Since the judge is the thirteenth member of the jury, he is privileged to set the verdict aside and grant a new trial if he thinks the award is not equitable or there have been errors in the trial. His opinion can be overruled by the higher courts. An appeal is expensive because of the cost of preparing the transcript of testimony. Usually a new trial results in a defense verdict, but occasionally there is an increased award.

Out of Court Settlements. There are as many out of court settlements as suits because the defendant would rather pay than be subjected to the adverse publicity, particularly in vasectomies, but they are not in the record. Whenever there is any question of real malpractice, the case is always settled, if it can be done within a reasonable amount. Frequently the plaintiff obtains more by settlement than would be awarded by a jury. Large out of court settlements, when there is no negligence, are due to fear by the defendants of large judgments, or ordeal of a long court trial.

CONCLUSION

Malpractice suits are usually filed by labile or money hungry persons, and we would not

be vulnerable had we not departed from the teachings of Aesculapius, the legendary father of medicine. "He exhibited the powers of his art only to persons who, being generally of healthy constitution and habits of life, had a definite ailment . . . He did not want to lengthen out good-for-nothing lives, or to have weak fathers begetting weaker sons:—if a man was not able to live in the ordinary way he had no business to cure him; for such a cure would have been nó use to either himself, or to the State." (Plato, Republic).

The modern doctor is so busy emulating the great physician, the apostle, St. Luke, that he forgets the precepts of Aesculapius, and as a result some have to submit to a barrage of innuendoes in open court from a man he would not permit in his house.

SPECIAL DEPARTMENTS

Our Surgical Heritage

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UNITED STATES OF AMERICA

GURDON BUCK

GURDON BUCK (Buck's extension) was born on May 4, 1807, in New York City. He attended a Classical School in New York and pursued a business career for a short time after which he became an apprentice to Dr. Thomas Cook. He entered the College of Physicians and Surgeons of New York and received the degree of Doctor of Medicine in 1830, after which he served as an interne in the New York Hospital for a year and a half. Buck, always of an inquisitive mind, journeyed to Paris, Berlin and Vienna in 1832 where he studied for two and a half years. In 1835, he returned to Europe and married Henrietta E. Wolff of Geneva, Switzerland. After his return to New York in 1837 he was appointed Visiting Surgeon to the New York Hospital.

Buck was one of the early researchers in surgery. In 1845 he described Buck's operation which was excision of the knee joint, and in 1848 he described Buck's fascia. In 1861 Buck described Buck's extension for the

treatment of fractures of the thigh, and at this time he attended casualties of the American Civil War after the battles of Antietam and the Wilderness. This method of treating fractures of the thigh is well known to every general surgeon of our time.

Gurdon Buck was the Visiting Surgeon to the New York Hospital, the New York Eye and Ear Infirmary and the Presbyterian Hospital of New York. He was a prodigious writer and contributed approximately ninety-four articles to surgical literature. Buck died of uremic poisoning on March 6, 1877.

Gurdon Buck was a very religious and charitable man. He had a high sense of professional honor which was near puritanical in its standards.

EUROPE

SIR WILLIAM FERGUSSON

Sir William Fergusson was born at Preston Pans, Scotland, on March 20, 1808. He is best remembered for his Fergusson's speculum, mouth gag, bone forceps and for his great record in the surgery of cleft palate. Before anesthesia and asepsis were used, he performed 134 operations for cleft palate, 129 of which were successful. He had only three failures in operations for 400 operations for harelip.

William Fergusson received his high school education in Edinburgh, after which he worked for approximately two years in a lawyers office. This he found unattractive to his nature and began the study of medicine in Edinburgh at the age of seventeen. Robert Knox who was at the time the master teacher of anatomy in Edinburgh saw the spark of genuis in Fergusson and appointed him his chief assistant in the dissecting rooms at the Old Surgeons Hall. About 400 students were in daily attendance at this institution.

In 1828 Fergusson became a member and in 1829 a Fellow of the Royal College of Surgeons of Edinburgh. In 1831 he was appointed house surgeon to the Edinburgh Royal Dispensary and in 1836 was elected surgeon to the Royal Infirmary.

In 1833 Fergusson married Helen Ranken, an heiress, and thus his financial security was guaranteed. In 1840 he was appointed Professor of Surgery at King's College and Surgeon to King's College Hospital, London. He was made a member of the Royal College of Surgeons of England in 1840 and an honorary Fellow of the College in 1844.

Fergusson attained a large surgical practice in London which pyramided after the death of Robert Liston in 1847.

Fergusson was an early advocate of resection or excision of joints instead of amputation and thus became one of the very few who could claim the practice of conservative surgery.

In 1842 his book entitled "A System of Practical Surgery" was published in London and Philadelphia. It became popular immediately going thru five editions and was translated into German.

It is interesting to note that while Fergusson was assistant to Robert Knox about the year 1827 in Edinburgh, he was involved with his chief and two other assistants in receiving subjects for anatomic dissection from the team of Burke and Hare who became notorious for murders and selling the subject to dissecting rooms. It was thus that the term, Burkeing the patient, was born.

Sir William Fergusson died of acute nephritis on January 10, 1877, and was buried at West Linton, Scotland. The great oak of British surgery fell.

BOOK REVIEWS

Exercise and Fitness. A Collection of Papers Presented at the Colloquium. 248 pages. The Athletic Institute. Chicago, 1960.

This volume is a soft cover book described on its fly leaf as a collection of papers presented at the Colloquium on Exercise and Fitness, December 6 through 8, 1959, at the University of Illinois College of Physical Education and The Athletic Institute. The book includes, among others, six papers on the medical aspects of exercise and fitness by physicians who are interested and active in the American College of Sports medicine. These chapters principally cover the cardiac implications of exercise and frequently emphasize pathology instead of normal physiology. The several other general headings include the physiologic aspects of exercise, the nutritional aspects, the psychologic aspects and physical education as it relates to exercise and fitness. The great majority of the participants were teachers of physical education from the various universities and I believe the presentations were geared to their level. Physicians probably will not be challenged by the book, however, it can serve as an introduction to an important and timely subject.

E. W. J.

Cardiac Auscultation, 2nd Edition. By J. Scott Butterworth, Maurice R. Chassin, Robert McGrath, and Edmund H. Reppert. 102 pages. Grune & Stratton, Inc. New York, 1960. *$6.25.*

In the preface of the second revised and enlarged edition of *Cardiac Auscultation* the authors express the intention of stressing practicability and brevity. They emphasize that the text is not intended as a comprehensive work on cardiology. Within these intended limitations, they fulfill the task admirably. The principles of clinical cardiovascular auscultation are presented succinctly. References are few. Simplicity is maintained by the omission of controversial points.

Such a book is intended for the busy physician or student interested in understanding and applying the basic principles of cardiac auscultation.

The publishers disappointed this reviewer by providing him with a copy that has missing pages.

It is recommended reading for the intended audience.

C. F. W.

Annals of the New York Academy of Science. Fourth Tissue Transplantation Conference, Volume 87. Article 1. Edited by Otto V. St. Whitelock, 607 pages. The New York Academy of Sciences, New York, 1960. *$5.00.*

The three previous homotransplantation conferences which have been given by the New York Academy of Sciences and which have been published in their bulletin, have been collector's items and outstanding works in the field of homotransplantation. The fourth issue is of the same high quality and caliber. Basic research in the field of homotransplantation is included in this volume and it offers a distinct contribution to this wide and fast growing field.

It may be well to mention that contributions from the Russian physicians have helped in illuminating the value and possibility of segmental transplantation. It is also interesting to note the variety of work throughout the world which is uniting in a common effort. The volume is a noted contribution in the field of homotransplantation by the New York Academy of Sciences.

F. M.

BOOKS RECEIVED FOR REVIEW

All books received will be acknowledged in this column. Insofar as possible, as space permits, books of special interest will receive more extensive reviews.

An Atlas of Ophthalmic Surgery. Conrad Barens, M.D., F.A.C.S., et al. 603 pages. J. B. Lippincott Co. Philadelphia, 1961. *$28.00.*

Respiration in Health and Disease. R. M. Cherniak, M.D., F.A.C.S. 376 pages. W. B. Saunders Co. Boston, 1961.

PUBLISHER'S INFORMATION PAGE

The Editors and Publishers of **The American Journal of Surgery** welcome concise articles on new findings in surgery, especially shortened manuscripts (not case reports). Ten minute scientific papers are the type sought, and will be given early publication. As is customary in professional publications, statements in articles are the responsibility of the authors; articles must be contributed solely to **The American Journal of Surgery**; material is copyrighted and may not be reproduced without permission of the publishers.

Preparation of Manuscripts

Authors are requested to follow these instructions carefully in preparing manuscripts: Please double space with good margins; type on one side of the sheet only; make a carbon copy for yourself and send the original with one carbon copy to the editor; include full name, degrees, staff position and affiliation; list bibliographic references in numerical order as referred to in text at the end of the article (not in footnotes). Please make certain each reference contains the name of author with initials; title of article; name of periodical, with volume, page and year. For example: BARKER, W. F. Surgical treatment of ulcerative colitis. *Am. J. Surg.*, 102:176, 1961.

Preparation of Illustrations

So that your article will be presented most effectively, illustrations must be glossy prints or professional drawings in black ink (never in blue; it will not reproduce well). All printing on illustrations should be done professionally. Reference to all illustrations should be inserted in the text in consecutive order. Please follow these identification instructions: Write the figure number and the author's name on the back of each illustration and indicate the top.

Type legends for illustrations on a separate sheet with numbers corresponding to those on the photographs or drawings. Please do not attach legends to the pictures.

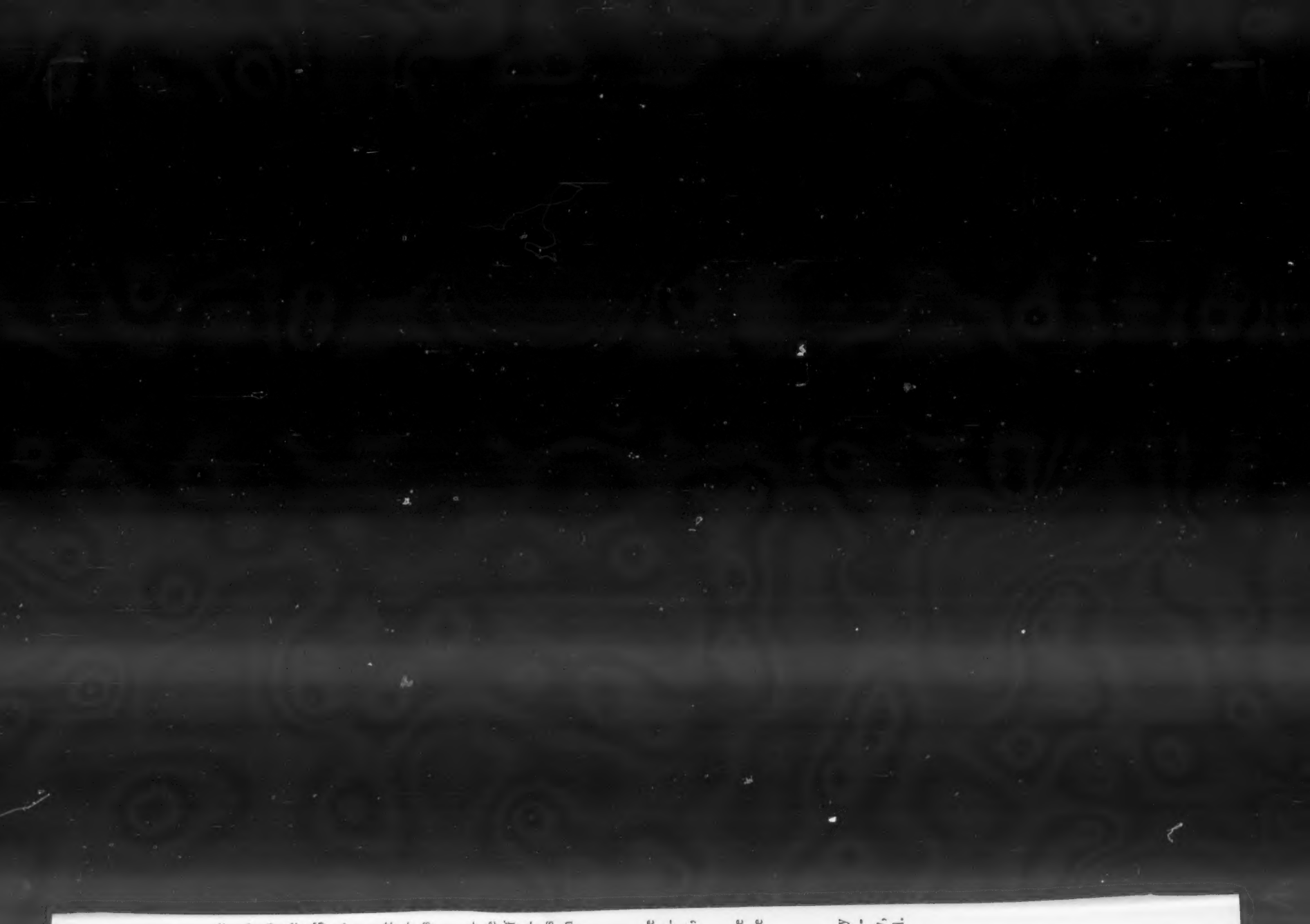
A minimum of illustrations, professionally prepared, is encouraged and will receive favorable consideration. While a reasonable number of illustrations is supplied free of cost, special arrangements must be made with the publishers for excess illustrations and tables and reproduction of color.

Reviews, Abstracts

Books for review may be sent directly to the Editor, Robert M. Zollinger, M.D., Chairman, Department of Surgery, The Ohio State University, Columbus, Ohio.

Permission to abstract must be obtained from the publisher. Only paid circulation journals will be permitted to abstract.

Reprints

Orders for reprints of articles should be sent directly to the publisher, **The American Journal of Surgery, Inc.**, 466 Lexington Avenue, New York 17, N. Y. Prices are quoted after articles are published.

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